

**FOREIGN
BROADCAST
INFORMATION
SERVICE**

JP RS Report

Science & Technology

***Central Eurasia:
Engineering & Equipment***

Science & Technology

Central Eurasia: Engineering & Equipment

JPRS-UEQ-92-003

CONTENTS

12 March 1992

Aviation and Space Technology

- New Soviet Hypersonic Air-Breathing Ramjet Engine Discussed [IZVESTIYA, No 36, 13 Feb 92] 1
- Oscillation Stability of Simple Pendulum on Moving Frame at Upper and Lower Trajectory Points
[K.N. Shevchenko; DOKLADY AKADEMII NAUK SSSR, Vol 319 No 2, Jun 91] 1

Optics, High Energy Devices

- Unsteady Thermoelastic Straining of Cooled Laser Mirrors
[N.I. Golovchenko, I.V. Milov, et al.; INZHENERNO-FIZICHESKIY ZHURNAL, Vol 61 No 2, Aug 91] 3
- Electronic Distance Measurement [F. N. Gavrilov; GEODEZIYA I KARTOGRAFIYA, No 6, 91] 3
- The Formation Mechanism of a Solid-Phase Joint in a State of Superplasticity
[O.A. Kaybyshev, R. Ya. Lutfullin, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, 91] 3

Nuclear Energy

- SOS From the Earth [A. Penyagin; MEDITSINSKAYA GAZETA, 13 Dec 91] 5
- Comprehensive Assessment of Certain Heat Insulating Material Properties for Nuclear Plants
[V.G. Yurchenko, G.A. Nazarova, et al.; ENERGETICHESKOYE STROITELSTVO, Dec 91] 8
- On Increasing Nuclear Power Plant Pipeline Reliability During Earthquakes
[I.V. Kaliberda; ENERGETICHESKOYE STROITELSTVO, Dec 91] 8
- Design of Filtration-Arresting 'Underground Bulwark' to Ameliorate Consequences of Chernobyl Nuclear Power Plant Accident
[N.V. Dmitriyev, L.I. Malyshev, et al.; ENERGETICHESKOYE STROITELSTVO, Dec 91] 8
- Seismic Stability of Production Equipment: Ensuring Seismic Stability of Crucial Industrial Facilities
[S.P. Kaznovskiy, I.N. Ostretsov; TYAZHELOYE MASHINOSTROYENIYE, Aug 91] 8
- Seismic Stability of Production Equipment: Power Valve and Accessory Feasibility Analysis Experience
[I.I. Golenkov, V.I. Yesman, et al.; TYAZHELOYE MASHINOSTROYENIYE, Aug 91] 9
- Seismic Stability of Production Equipment: Seismic Stability Criteria of Nuclear and Fossil Fuel Power Plant Turbogenerator Sets
[V.V. Kostarev, A.M. Berkovskiy; TYAZHELOYE MASHINOSTROYENIYE, Aug 91] 9
- Seismic Stability of Production Equipment: Seismic Stability Feasibility Analysis of Kozloduy Nuclear Power Plant Turbogenerator Building Pipelines
[S.V. Bazilevskiy, A.A. Sokolov, et al.; TYAZHELOYE MASHINOSTROYENIYE, Aug 91] 9
- Seismic Stability of Production Equipment: Efficiency Analysis of Seismic Pipeline System Uncaging
[V.I. Avdeyev, P.N. Nikitenko; TYAZHELOYE MASHINOSTROYENIYE, Aug 91] 10
- Seismic Stability of Production Equipment: Seismic Stability Criteria and Seismic Response Analysis of High-Power Boilers [A. Yu. Shchukin; TYAZHELOYE MASHINOSTROYENIYE, Aug 91] 10
- Selecting Mining of Uranium Ore Beds Using Bucket-Wheel Excavators
[Ye.A. Kotenko; GORNYIY ZHURNAL, May 91] 10
- Outlook for Using Shape Memory Alloys in Nuclear Power Industry
[F.M. Mitenkov, O.B. Samoylov, et al.; TYAZHELOYE MASHINOSTROYENIYE, Jul 91] 11
- Prediction of Ground Water Contamination With Radionuclides During Nuclear Power Plant Construction Site Selection [S.V. Alyutova; ENERGETICHESKOYE STROITELSTVO, Jun 91] 11
- Procedure for Analyzing Economic Efficiency Indicators of Nuclear Power Plants With Water-Cooled Water-Modulated Power Reactors and High-Power Pressure-Tube Reactors
[Ye.I. Dyakonov, Ye.I. Ignatenko; ENERGETICHESKOYE STROITELSTVO, Jun 91] 11
- Ukrainian Nuclear Security Committee [NARODNAYA ARMIYA, 20 Feb 92] 12
- Nuclear Power Plant Testing. Classification and Analysis of Operator Error in Single-Loop Nuclear Power Plant
[A. A. Mikhalevich, S. N. Rymarchik; IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK, Apr-Jun 91] 12

Heating of Nuclear Fuel Specimens by Microwave Radiation in High-Q Resonators [V. S. Vysotskiy, A. A. Posivets, et al.; IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK, Apr-Jun 91]	12
Calculating Natural Fuel Operating Mode in Fast-Neutron Reactors With Varying Fuel Burnup [B. V. Mishanin, G. B. Usynin, et al.; IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK, Apr-Jun 91]	12
The Heat Effect of Power Generation Structures as a Possible Source of Disturbance of Seismotectonic Equilibrium [P. Ye. Kotlyar, B.M. Chikov, et al.; GEOLOGIYA I GEOFIZIKA, Aug 91]	13
Calculating the Dose Rate of Outside γ -Irradiation [R.V. Arutyunyan, L.A. Bolshov, et al.; DOKLADY AKADEMII NAUK SSSR, No 3, 91]	13
Solving Ecological Problems When Developing New Designs for Safer AES With VVER Reactors [L.M. Voronin, V.M. Berkovich; TEPLOENERGETIKA, Dec 91]	14
Formulation of the Problem of Diagnosing the Processes and Equipment of the NSSS of a BN-600 Unit [A.G. Sheynkman, V.D. Kozyrev; TEPLOENERGETIKA, Dec 91]	14
An Automated Subsystem To Monitor and Control the Water-Chemical Regimen of the Secondary Loop of an AES With a VVER Based on the Kompleks-Titan-2 Control Computer Complex [V.A. Mamet, P.N. Nazarenko, et al.; TEPLOENERGETIKA, Dec 91]	15

Non-Nuclear Energy

Problems of Rebuilding Razdan Regional Power Plant After Earthquake [I.N. Alkhovskiy; ENERGETICHESKOYE STROITELSTVO, Jun 91]	16
'Turboatom' Scientific Production Association Is Developing and Upgrading Turbine Plants for Thermal Power Plants [M.A. Virchenko, Yu.F. Kosyak, et al.; ENERGETIK, Jul 91]	16
A Comprehensive Investigation of Steel Corrosion Products Formed in Straight-Through Demineralized Water During Polarization and Oxygen Passivation [N.V. Ivanova, M. Ye. Shitsman; ELEKTRICHESKIYE STANTSII, Dec 91]	16

Turbines, Engines, Propulsion Systems

Calculating Gas Turbine Engine Parts' Coefficient of Strengthening by Balls in Ultrasonic Field [V.K. Yatsenko; PROBLEMY PROCHNOSTI, Aug 91]	17
---	----

Mechanics of Gases, Liquids, Solids

The Contact Explosion of a Cylindrical Explosive Charge Buried in Soft Soil [A.V. Krymskiy, A.S. Udalov; IZVESTIYA AKADEMII NAUK SSSR: MEKHANIKA TVERDOGO TELA, No 6, Nov-Dec 91]	18
--	----

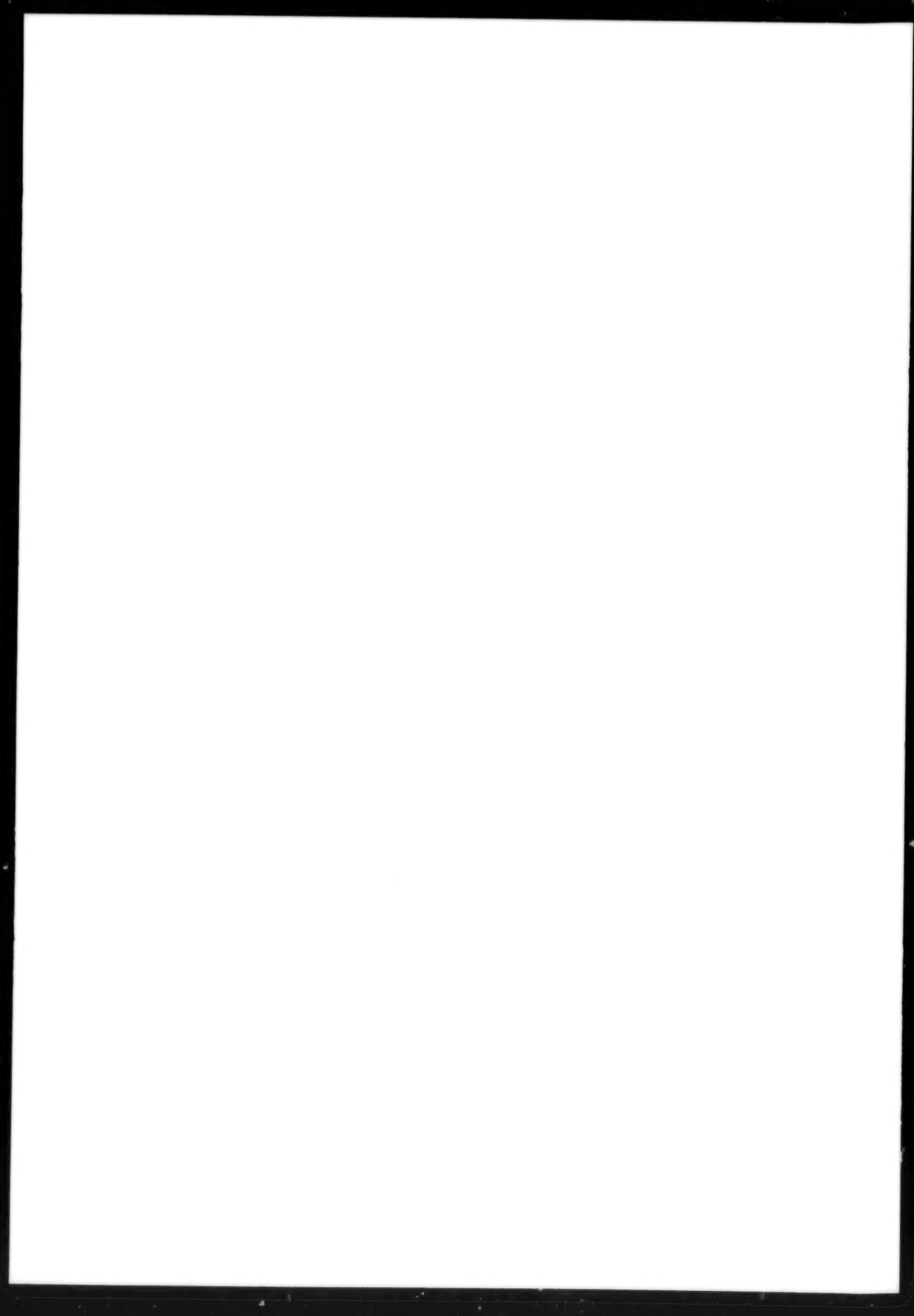
Industrial Technology, Planning, Productivity

On Criteria Approximation in Dynamic Synthesis Problems of Manipulator Robots [A.G. Perevozchikov, V.V. Fedorov; DOKLADY AKADEMII NAUK SSSR, Vol 320 No 1, Sep-Oct 91]	19
Operational Durability of Carbon and Vanadium Steel Wheels in Passenger Trains [L.M. Shkolnik, A.V. Fofanova, et al.; VESTNIK VSESOYUZNOGO NAUCHNO- ISSLEDOVATELSKOGO INSTITUTA ZHELEZNODOROZHNOGO TRANSPORTA, No 5, Jul-Aug 91]	19
Mobile Unit for Opening and Closing Railroad Gondola Car Hatches [N. Ye. Smirnyagin, Yu.A. Antonov; MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA, Jun 91]	19
New Methods of Hardening Rail Tie Plates [V.M. Fedin, L.P. Strok, et al.; VESTNIK VSESOYUZNOGO NAUCHNO-ISSLEDOVATELSKOGO INSTITUTA ZHELEZNODOROZHNOGO TRANSPORTA, No 5, Jul-Aug 91]	19
Investigation of R65 Rail Reliability Using Weibull's Distribution [A.V. Gavrilentov, L.G. Krysanov; VESTNIK VSESOYUZNOGO NAUCHNO- ISSLEDOVATELSKOGO INSTITUTA ZHELEZNODOROZHNOGO TRANSPORTA, No 5, Jul-Aug 91]	20

New Sections for Car Building and Their Utilization Efficiency [S.Ye. Odinokov, A.I. Shakhparonov; <i>TYAZHELOYE MASHINOSTROYENIYE</i> , Jul 91]	20
---	----

Miscellaneous

IT-5 Automated Unit for Measuring Thermal Conductivity of Nonmetallic Materials [T.G. Grishchenko, P.V. Katsurin, et al.; <i>IZMERITELNAYA TEKHNICA</i> , Jun 91]	21
Low-Frequency Sound Receiver for Operation Under Natural Conditions [V.I. Albul, A.F. Kurchanov, et al.; <i>IZMERITELNAYA TEKHNICA</i> , Jun 91]	21
Electron Beam Probing of Charged Particle Beams With Rectangular Cross Section [A.I. Shitakov, V.N. Azarov, et al.; <i>IZMERITELNAYA TEKHNICA</i> , Jun 91]	21
Design Principles of Multifunction Charged Particle Beam Transducers Based on Electron Beam Probing Methods [V.N. Azarov; <i>IZMERITELNAYA TEKHNICA</i> , Jun 91]	21
Algorithmic Error Reduction of Beam Parameter Measurements by Electron Beam Probing Method [V.A. Agibalov, V.P. Shestak; <i>IZMERITELNAYA TEKHNICA</i> , Jun 91]	22
Device for Measuring Rigid Body Inertia Tensor [Ye.V. Buyanov; <i>IZMERITELNAYA TEKHNICA</i> , Jun 91]	22
Thin Film Temperature-Sensitive Resistors With Improved Accuracy and Negative Temperature Coefficient of Resistance [V.N. Novikov, A.Ye. Pronkina; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , May 91]	22
First Commercial Posistor Design for Current Protection of Electronic Equipment [G.N. Tekster-Proskuryakova, Yu.A. Gusev, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , May 91]	23
Oxide-Semiconductor Thick Film Temperature-Sensitive Resistors [V.I. Zakharov, Yu.A. Gusev, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , May 91]	23
Semiconductor Temperature-Sensitive Resistor-Based Temperature-Sensitive Elements [V.S. Moskalev, L.A. Sverzhin; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , May 91]	23
Microprocessor Thickness Gauge [V.I. Loban, A.A. Pyzhyanov, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , May 91]	23
Contactless Optical Displacement Transducer [T.I. Murashkina; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jul 91]	24
Effect of Accelerometer Sensor's Added Mass on Its Frequency Response [V.A. Volkov, V.V. Ryzhanov, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jul 91]	24
Quick-Response Posistor Sensors for Electrical Machine Temperature Protection [Yu.A. Gusev, M.B. Druzhinina, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	24
Use of Varistors as Temperature-Sensitive Element Sensors With Linear Response [I.P. Rayevskiy, F.K. Medvedev, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	24
Semiconductor Pressure Pickup With Increased Reliability and Improved Technical Effectiveness [L.V. Sokolov; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	25
Thin Film Heated Electrolytic Humidity Sensor [T.A. Dyakonova, V.Ye. Lystsev; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	25
MIS Structure-Based Hydrogen Sensor [V.P. Kozlenkov, I.N. Nikolayev; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	25
Gastroenterology Probe [Yu.I. Zaganyach, A.P. Kutakov, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	25
Determining Nonlinearity and Hysteresis of Low-Pressure Manometers [A.P. Bazhanov, V.A. Kryukov, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jul 91]	26
Sh711/1 Multichannel Digital Transducer [V.M. Mashenkov, Yu.A. Notkin, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jul 91]	26
FET Parameter Meter for Process Control Structures [V.F. Ryzhkov, V.I. Ryabinin, et al.; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jul 91]	26
Displacement Transducers With High-Frequency Ultrasonic Raster [V.Yu. Snitko; <i>PRIBORY I SISTEMY UPRAVLENIYA</i> , Jun 91]	27



New Soviet Hypersonic Air-Breathing Ramjet Engine Discussed

927F0095A Moscow IZVESTIYA in Russian
No 36, 13 Feb 92 pp 1, 2

[Unattributed article: "We Have Created the World's Best Engine and Once Again Do Not Know How To Deal With It"; first paragraph is boldface IZVESTIYA introduction; photograph of Sergey Leskov and Yuriy Inyakin (not reproduced)]

[Text] It has already become a sad tradition the first news we hear about new sensations in our country comes from Western information agencies. And so once again, a number of American and French publications have issued reports of flight tests of a hypersonic air-breathing ramjet engine in the former Soviet Union. Similar tests are planned in the United States and other developed countries in 3 to 4 years at best.

The hypersonic aircraft is capable of climbing into space after taking off from a runway and is, according to the specialists, an aircraft of the 21st Century. Unfortunately, because of the strict secrecy surrounding research on air-breathing ramjet engines, the Western publications were not permitted to publish many details. Today, on the basis of materials provided by one of the creators of this unique engine (A. Rudakov, department head at the Central Institute of Aviation Engine Building), IZVESTIYA is the first newspaper to tell of this unrivaled aircraft.

The creation of aircraft based on hypersonic air-breathing ramjet engines is considered a complex scientific problem that marks a qualitatively new stage in conquering the air and outer space. Suffice it to say that a flight in an aircraft equipped with such an engine will take no more than 1.5 to 2 hours. Indeed, the creation of this engine has been considered the main engineering obstacle in the entire problem. Testing the engine on the ground is very expensive and virtually impossible in its main modes (at speeds of more than 9,000 km/h). Even powerful modern computers cannot provide the required computational reliability.

But on 28 November 1991 the world's first flight test of the hypersonic air-breathing ramjet engine was conducted in Kazakhstan. The engine was mounted in the nose section of a 2-stage earth-air class rocket. The speed of sound was exceeded six times during the tests. The previously unsolvable problem of fueling and feeding liquid hydrogen (which has a temperature of -253°) to the engine was solved successfully. It was possible to provide a temperature of more than 2,000° at the inlet. Any air or space power would envy the successful tests of the hypersonic air-breathing ramjet engine. Prof. D. Ogorodnikov, who is currently the director of the Central Institute of Aviation Engine Building, has been directing the new engine's development for 20 years now. It is important to emphasize that this engine is one of the many examples of our highly qualified conversion: the project has used developments taken mainly from weaponry and military

technology slated for destruction. The cutting-edge technology developed when the air-breathing ramjet engine was created may, according to the experts, find wide-scale use in various sectors of the national economy. Commenting on the obvious embarrassment of the U.S. administration, the renowned American engineer Paul Tsish [transliteration], who was recently the director of the corresponding program at McDonnell-Douglas, stated the following: "We here are just trying to obtain data on a hypersonic air-breathing ramjet engine, while in Russia one is already flying. Why weren't we first?" According to foreign data, plans call for reaching a speed ten times faster than the speed of sound in the next series of tests. Our specialists are more precise: The engine will endure this load, but the acceleration will require a powerful medium-range ballistic rocket.

The Americans are well aware of another non-confidence-inspiring fact, however. These tests are of little practical value to the former USSR for the very prosaic reason that the country's economy is in ruins and the aerospace infrastructure is finished. The means to bring this unique aircraft to completion may simply not exist. Along these same lines, a number of commentators have said that the air-breathing ramjet engine was the beginning of the end of world-class engine building in the decaying USSR. As the weekly publication AVIATION WEEK AND SPACE TECHNOLOGY has confirmed, engineers in the United States, Germany, Japan, and especially France are today vying with each other to court the Russians so as to obtain data regarding the hypersonic tests that would be crucial in the coming technological race. Whoever obtains the greatest access to Russian information will be the envy of the entire world, and at the same time we don't know how to handle these achievements. Once again, our only hope is for cooperation with foreigners, which is humiliating for a once-mighty power. For the sake of comparison, the Bush administration requested \$260 million in funding for fiscal 1993 for a program to create an aerospace craft. In our budget, financing for 1992 for the air-breathing ramjet engine has not yet been revealed. For this reason, it is not known whether new tests of this unique engine will be conducted.

Oscillation Stability of Simple Pendulum on Moving Frame at Upper and Lower Trajectory Points

927F0069A Moscow DOKLADY AKADEMII NAUK
SSSR in Russian Vol 319 No 2, Jun 91 pp 304-309

[Article by K.N. Shevchenko; submitted by Academician A.A. Dorodnitsyn]

UDC 531.532

[Abstract] The contribution of N.N. Bogolyubov's school to studies of nonlinear pendulum oscillations, viz., in developing a theory of integrating nonlinear differential equations describing pendulum-type oscillatory systems,

is recognized and the stability conditions of a simple pendulum at the upper and lower points of its trajectory are investigated by the classical mechanics methods. To this end, two methods of classical mechanics are considered: the vibration method and the moment method. In the former case, one of the most fundamental problems of nonlinear oscillatory systems—finding the conditions of the simple pendulum motion stability at the lower and

upper trajectory points under the effect of vibration on the pendulum is solved; the solution's two parts are found by Mathieu's method and by the compressed spring method. In the latter case, the stability conditions largely depend on the external moment created by the work of a mobile motor. The contribution made by Ye.F. Mishchenko and Yu.A. Mitropolskiy is mentioned. Figures 4; references 4.

Unsteady Thermoelastic Straining of Cooled Laser Mirrors

927F0071A Minsk INZHENERNO-FIZICHESKIY
ZHURNAL in Russian Vol 61 No 2, Aug 91 pp 190-198

[Article by N.I. Golovchenko, I.V. Milov, I.L. Strulya, V.V. Kharitonov, Moscow Engineering Physics Institute]

UDC 539.377:621.375.826

[Abstract] The difficulty and high cost of designing, manufacturing, and testing high-energy laser mirrors, especially studying the unsteady straining of illuminated reflectors, are addressed and a technique for analyzing the unsteady three-dimensional temperature distributions and thermoelastic distortions developing in parallelepiped-shaped cooled laser mirrors is presented. The procedure takes into account the characteristics of spatial distribution of the thermal load, anisotropy of the coefficient of thermal conductivity, and the coolant heating in the cooling system. The nontrivial results of thermal distortion analyses of the reflecting surface of rectangular mirrors with a slotted microchannel cooling system are cited. The effect of the luminous flux nonuniformity, the unsteady thermal process state, the mirror design and material, the cooled layer structure, and coolant rate on thermal straining is investigated. A numerical analysis program developed on the basis of the study makes it possible to optimize the geometrical configurations of the cooling system and coolant rate for each structural material and beam load profile. Figures 6; tables 1; references 8.

Electronic Distance Measurement

927F0041A Moscow GEODEZIYA I KARTOGRAFIYA
in Russian No 6, 91 pp 48-49

[Abstract of article by F. N. Gavrilov]

UDC 528.425

[Abstract] The Omskgeprovodkhoz Institute has developed an electronic distance measurement (EDM) method used to construct topographic maps in real time and to perform a number of other civil and industrial surveying tasks. The EDM equipment consists of a Ta-3 "Agat" electronic tacheometer, an Elektronika MK-52 internal computer that performs all calculations in real time, permanently stored software for on-site data processing and mapping control, three or four ultra-short-wave radio stations with 1-3 km ranges, a manually operated mechanical coordinate plotter, stadia rods three to four meters in length fitted with reflectors and screens, and a plane table. An ideal EDM crew is one engineer to operate the tacheometer, a topographer to plot the survey stake coordinates and construct the map, and two rodmen. Survey parameters are 200 sq km on a scale of 1:5000 with a relief cross-section height of 0.5 m;

100 sq km on a scale of 1:2000 with a relief cross-section heights of 0.25 and 0.5 m; and 30 and 20 sq km on scales of 1:1000 and 1:500, respectively. The topographer is free to move about the section being surveyed and plots the X, Y, and H coordinates of the survey stakes "by ear" from the display device of the tacheometer. Plotting error does not exceed 0.2 mm of map scale. A manual on the practical applications of EDM has been published by Nedra (Moscow, 1989). The book covers the use of the aforementioned equipment and automated geodesic data collection. It also discusses the best ways to establish base lines in real time and how to calculate and make adjustments for vertical refraction.

The Formation Mechanism of a Solid-Phase Joint in a State of Superplasticity

927F0098A Moscow DOKLADY AKADEMII NAUK
SSSR in Russian No 3, 91 (manuscript received
13 May 91) pp 615-618

[Article by O.A. Kaybyshev, R.Ya. Lutfullin, and V.K. Berdin, Institute for the Problems of Superplasticity of Metals, USSR Academy of Sciences, Ufa]

UDC 669-172:621.791.4

[Abstract] The authors of the study reported herein examined the formation mechanism of a solid-phase joint in a state of superplasticity. As a study object they selected the ($\alpha + \beta$) titanium alloy VT-14 (Ti-4.5% Al-3.0% Mo-1.0% V) in the form of sheets 0.8 mm thick with a microcrystalline structure (grain size, 1-2 μm). The quality of the solid-phase joint formed during diffusion welding was determined by mechanical tests of welded specimens that were performed by using an Instron model 1185 universal dynamometer. To determine the characteristic features of the formation of a solid-phase joint, the authors devised an experiment that included three main steps. The first step was designed to determine the optimal temperature and deformation rate conditions for the manifestation of superplasticity in VT-14. The optimal temperature was found to be 860°C, and the optimal rate of superplastic deformation was found to be 4.0×10^{-4} /s. Next, sheet blanks of VT-14 were pressure-welded until a joint strength of 245 MPa (constituting 0.4 relative units of the main material's strength) was reached. The same blanks were also subjected to hot plastic deformation based on a scheme using uniaxial tension at the aforesaid optimal temperature in three different deformation rate ranges. In the third step of the experiment, control blanks were annealed after preliminary welding at the optimal superplasticity temperature for periods equal to the deformation times of the basic test specimens. This annealing was performed in an SNVE-1.3116 vacuum furnace in a vacuum of 4.0×10^{-3} Pa. The structural changes occurring during the welding process with hot deformation were examined by using a JSM-840 scanning electron microscope. The experiments conducted demonstrated

that a uniformly strong joint could not be obtained in the microcrystalline alloy VT-14 when annealing was not accompanied by hot deformation. When blanks were annealed for different amounts of time up to 900 seconds, they displayed a weak tendency toward an increase in the strength of their solid-phase joint. As the duration of annealing was increased further, the joint's segregation stabilized at a level that was markedly lower than in specimens that had been deformed for a corresponding amount of time. The quality of the solid-phase joints tested was found to increase monotonically as deformation time (i.e., degree of deformation) increased. Joint

quality also proved to be very dependent on the deformation rate as well. The maximum strength, given identical solid-phase joint formation times, was achieved at a deformation rate of 4.0×10^{-4} /s. The experiment results were taken as a direct indication of the active development of grain boundary slip during the course of superplasticity deformation and its effect on the formation of a solid-phase joint. Metallographic studies of the test joints did not reveal any signs of recrystallization in the joint zone when blanks of VT-14 were deformed in the first and second superplasticity ranges. Figures 3; references 9: 6 Russian, 3 Western.

SOS From the Earth

927F0087A Moscow *MEDITSINSKAYA GAZETA*
in Russian No 50, 13 Dec 91 pp 1, 8-9

[Interview by *MEDITSINSKAYA GAZETA* correspondent N. Yefimova with A. Penyagin, chairman of the Nuclear and Radiation Safety Subcommittee of the Committee for Security of the USSR Supreme Soviet's Union Council: "SOS From the Earth"; first paragraph is source epigraph; paragraphs 2 through 9 are source introduction]

[Text] "There is one such hard-and-fast rule," the Little Prince told me later. "You wake up in the morning, wash, get yourself in order, and immediately get your planet in order"—Antoine de Saint-Exupery.

Hanging on the office wall of USSR People's Deputy A. Penyagin is a map of the 30-kilometer zone of the Chernobyl AES. On it the master of the office has placed special marks in the form of circles with different diameters to indicate contamination with strontium 90, cesium 137, and other radionuclides.

Explaining what is hidden behind each of them, he presents frightening facts. Here are two of them: The radioactive wastes at our 15 nuclear power plants total 35,000 Curie activity units. The Mayak Production Association in the Chelyabinsk Oblast contains over a billion curies. And it is just one military production facility.

In a word, the story still lies ahead. The master of the office has yet another unique map that he has been compiling for 2 1/2 years now. It contains all of the country's radioactive "spots"—accidents, explosions, and other sources of radioactive contamination. Even our untrained eyes can see how much of the Union's territory is marked and how small the gaps between them are.

There they are—the planet's sore spots. The region of the rivers Tom and Yenisey has hundreds of microroentgens per hour. That is a very high radiation level.

The Chernobyl area is alarming. It has suffered three serious accidents.

The earth has long been suffering from the horror and is sending SOS signals to other worlds. It warns, "Come to your senses, people. Think about your offspring!"

How can one explain the madness and resounding irresponsibility that many respected departments and ministries, including our health care policy, have displayed in this situation?

We put this question to A. Penyagin, chairman of the Nuclear and Radiation Safety Subcommittee of the Committee for Security of the Union Council of the USSR Supreme Soviet.

Penyagin: We deputies of the USSR Supreme Soviet are to blame only in that we did not take the fight against the

nuclear threat to the ranks of the Law. In this respect we are far behind the Western countries, where they already have such laws.

Question: Aleksandr Nikolayevich, we are a medical newspaper. We are therefore interested above all in matters of human health and how radiation affects it.

Penyagin: We have nowhere to escape from this theme because we have Yuzhnyy Ural, Chernobyl, Chazhma, and the Semipalatinsk proving ground.

Ground and atmospheric nuclear weapons tests have brought mankind and the earth at the very minimum a doubling of the radiation background.

Question: And how, Aleksandr Nikolayevich, do you assess the role of physicians? Indeed they should have become a wall of protection of the public's health.

Penyagin: In the territory of the Semipalatinsk proving ground in the fourth secret antibrucellosis dispensary they do not treat people. They merely observe them.

The situation is the same in the Chernobyl Oblast. For half a million irradiated citizens the country could only open one affiliate of the Biophysics Institute. And it only has 13 beds.

[Boxed item: The 30-kilometer zone around Chernobyl has died for hundreds of years. No one knows how many mutant bacteria there are because mankind has never lived so long under conditions of the aftereffects of immense radiation accidents.]

The physicians should have gone public with the fact that those irradiated at the Semipalatinsk proving ground and Yuzhnyy Ural have been left without help. And there are other regions as well. There is the Novaya Zemlya proving ground, and there are the underground nuclear explosions that emit radionuclides outward. Why are the physicians silent about this? Why don't they sound an alarm about how we absolutely must look after the health of the children in these territories. My heart no longer aches for the adults.

Question: Perhaps the physicians are not to blame? They received their orders "from the top."

Penyagin: That's not exactly how it was. They themselves prepared the medical recommendations that have been issued everywhere. The recommendations were made by highly educated medical personnel and physicians, many of whom later became academicians. It was not the physicists who made the recommendations but the physicians. It was also the physicians who issued the 35 rem concept.

Question: What worries you most now?

Penyagin: Society's hardness. They have a very hardened attitude toward those who suffered in the radiation accidents. Oftentimes, people did not want to accept those evacuated from Chernobyl at their new locations.

A program for the Chernobyl, Kurgan, and Sverdlovsk oblasts is still being discussed.

At the very moment when we have for the first time managed to adopt independent laws in three republics—Ukraine, Belarus, and the Russian Federation—and then unify them into the Law of the USSR Supreme Soviet and approve a single legislature that would unite all of us on a common ground, the deputies from Ukraine refuse to sign, saying that Ukraine will deal with its misfortune itself.

[Boxed item: A nuclear warhead has a life of 7 to 10 years. In view of this, they must be taken out of the START provisions.]

The vast majority of the tens of thousands of nuclear warheads that have accumulated on earth are going around in circles. They are being reprocessed day and night. Are we being reliably protected from accidents with a "nuclear cocktail?"

And this view has its advocates in the republic. This means that people do not understand the problem at all and that either can't or don't want to understand it.

Question: What in your view must be changed without delay in order to halt the undesirable development of events? How can we help those people who have wound up in this radioactive dump (I am speaking figuratively)? How can we help our country and our planet as a whole?

Penyagin: First, they must learn what the real situation is. Lack of knowledge is the number one enemy. Serious organizational work is needed in each of the republics individually and in all of them together. All facilities that may pose a nuclear and radiation hazard must be known regardless of any secrecy or supersecrecy. And if something is rightly secret, then at least let it be known to a specified set of individuals whom the government has charge with monitoring facilities. There must be no neglect.

A map must be compiled and mark it to indicate those places where underground nuclear explosions and radiation accidents occurred so as to determine the current health status of those whose bodies the radionuclides entered. Those who are ill must be helped.

Radiation will not endure lies or deceit. It will not burn or break. It can go unnoticed for a long time and may be perceived as not being that critical. The problem therefore requires sufficient integrity on the part of all those who have any dealings with it. Decency is also required. We have lied so much about all this. We have classified as secret all thinkable and unthinkable records of the illnesses and sufferings of our own citizens whom radiation accidents have befallen.

[Boxed item: This files of the State Security Committee indicate that 50 terrorist acts related to facilities posing a nuclear threat have taken place throughout the world.]

Question: Do you think that your subcommittee has

succeeded in changing attitudes toward this vitally important question?

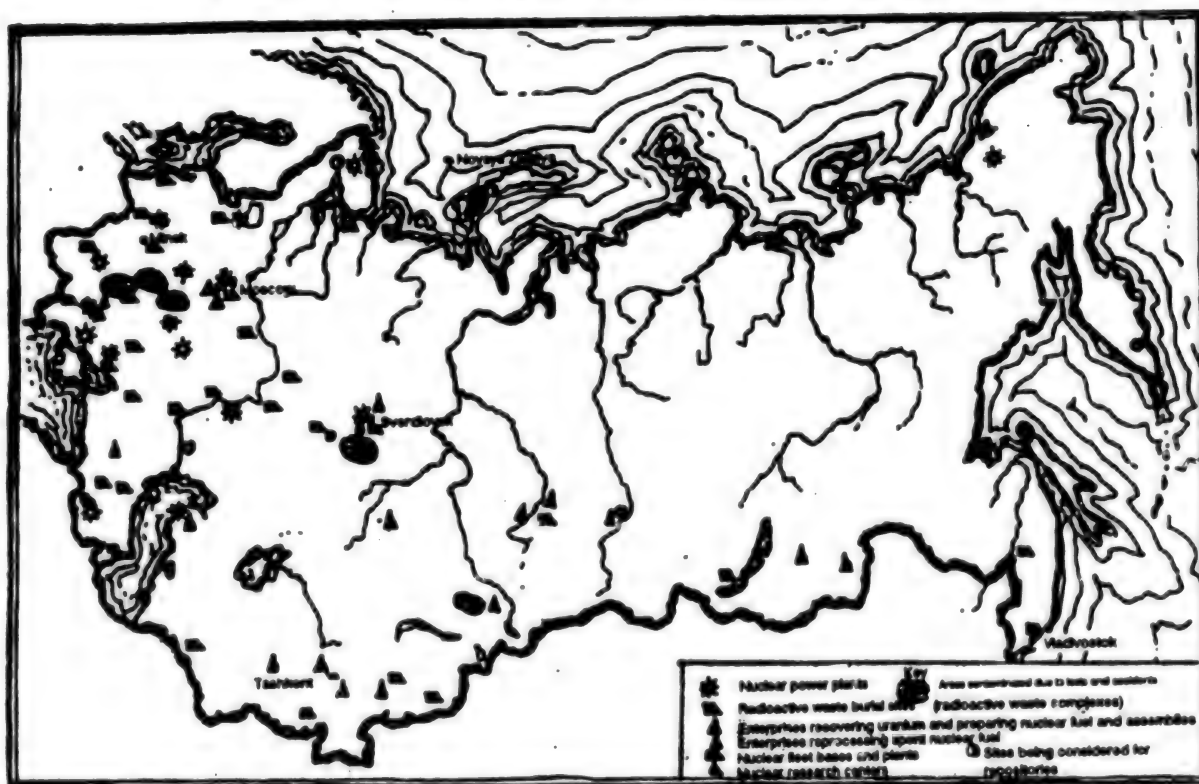
Penyagin: Of course it has succeeded. I am not saying this to call attention to my own services. Before the first Congress of USSR People's Deputies and before the elections of the members of the USSR Supreme Soviet almost nothing was known about Chernobyl. It was classified. And it was only thanks to the deputies from Ukraine, Belarus, and Russia that Chernobyl became known as it is today. This was done in spite of the official viewpoint. The same thing happened with Yuzhnyy Ural. Neither the USSR Council of Ministers headed by N. Ryzhkov nor the USSR Cabinet of Ministers headed by V. Pavlov ever even discussed draft legislation that would protect people in this situation.

Question: But perhaps a person would want to protect himself against radiation somehow. What does this require?

Penyagin: From the earliest age, when he has just learned to read and to understand what he has read, he should make an effort to "stamp out" his own ignorance with respect to radiation. There is even now a great deal of the most diverse speculation about radiation—medical, political, economic, national, and all other kinds as well. That is why each person must know (as difficult as it may be considering that there are no popular brochures on the subject) that when he flies in an aircraft at an altitude of 10,000 meters, he is in a zone where there may be 280 to 300 or more microroentgens per hour. That is the background. When he goes for an isotope study of his liver or thyroid gland he obtains a certain dose. What is a contaminated territory? How can there not be a state of confusion when a source is poured into metal and that metal later turns up throughout the entire country, emitting radiation in places where it will damage human health? We need to teach our children correctly. We must be certain that physicians understand people's anxiety correctly and that they fortify our health and serve us instead of not knowing which department to refer us to. [Boxed item: How fast should the production of plutonium and all nuclear weaponry be halted? What is the correct way to destroy it all with the least danger and risk? This has long ago ceased being a problem of just one country. It is a global, planetary problem.]

Let your newspaper ask physicians what their position is in the radiation situation in which our country has found itself. What is their position in this country that had the most radiation accidents in the world and where the absence of legislation and departmental rights have created so much that many many generations will have to unravel? What aftereffects should we now be monitoring in people who have already lived in contaminated territories for three generations? If medicine does not now utter its own humane and honest word, then I think that politicians may make a lot of extra work for us all.

Map Appended to the State Program To Localize Radioactive Wastes in the USSR



Question: But physicians also have a heap of problems. Domestic health care has a very weak material and technical base. There is no technology, and there are no drugs.

Penyagin: I feel that physicians initially had a greater problem when they were forced to keep everything secret. They wrote diagnoses that were completely false. And they wrote them for decades despite the fact that they took an oath to be true to their duty.

And now their hands are completely tied.

Even today, at the end of 1991, in regions of emergency radiation situations I have never encountered any written medical instructions about what people who have experienced problems should do or any other similar explanations. If you take a radiation dosimeter and see some number on the scale, you will stay calm. It is normal, it is within permissible limits. If you see another number, you should go to such and such a place, for example, to a sanitary epidemiologic station and ask whether or not it is harmful to your health. They should tell you where to call. If the answer you get does not satisfy you, they should tell you who specifically in your rayon, city, or oblast is responsible for safety from radiation effects.

And if our government has not yet learned to do this, then let us ask the physicians so that they can finally do

it in a qualified manner and so that they can say at the top of their voices that we cannot talk seriously with a person until we explain to him the degree of risk associated with living in a contaminated territory.

[Boxed item: The radiation background is multiplying everywhere—in China, the United States, the Soviet Union, France, and England. It has come to pass that everyone is accountable for the health of the earth's population. Everyone must answer for it.]

The radiation accidents that occurred 40-plus years ago have not become any less dangerous. And now in Tschou you can find spots where there are 2,000 microroentgens per hour. And it matters not that the discharge occurred in 1949. The radiation is still paying its dues today, and it will continue to do so tomorrow and the day after. In the best scenario, only one-tenth of the time has elapsed before this discharge becomes safe.

Postscript. It would be impossible, and no one is trying, to blame physician-scientists and health care organizers of voluntarily or involuntarily hiding the truth about radiation accidents. But with a view toward strict objectivity, it must be clearly stated that all decisions that have been made regarding these accidents have been made by the highest state and party bodies and by the government. And the USSR Supreme Soviet has not played its expected protective role.

Comprehensive Assessment of Certain Heat Insulating Material Properties for Nuclear Plants927F0105C Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 12, Dec 91 pp 42-43

[Article by V.G. Yurchenko, G.A. Nazarova, V.N. Yakunichev, V.V. Potulov, K.A. Kazakova]

UDC 621.311.25:621.039:662.998

[Abstract] The requirements imposed on heat insulating materials for nuclear plants (AS) and the criteria used for selecting them are outlined and the effect of the basic operating factors—temperature, ionizing radiation, and elevated moisture content—on the the most commonly used heat insulating materials is examined. To this end, the BSTV superthin basalt glass fiber cloth, stitched mineral wool unlined mats, the STV superthin glass fiber, and the MKRR-130 mullite silica glass fiber rolled material are investigated; in so doing, the density, thermal conductivity, hygroscopicity, compressibility, and water-soluble chloride and free alkali concentration in these materials as well as the effect of temperature, irradiation, and moisture content on them are determined. An analysis of the results demonstrates that insulators and products from the BSTV superthin basalt glass fiber cloth should be used in the hot zone; the STV superthin glass fiber should be used for equipment and pipeline protection only as part of multilayer insulation in the second or higher layer; and the use of mineral wool is not expedient in the hot zone. The materials under study are being tested at the Novovoronezh Nuclear Power Plant. Tables 3; references 4.

On Increasing Nuclear Power Plant Pipeline Reliability During Earthquakes927F0105B Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 12, Dec 91 pp 36-38

[Article by I.V. Kaliberda, Science and Engineering Center at the USSR State Atomic Power Inspection]

UDC 621.311.25:621.039.621.643.62-192

[Abstract] Several aspects of the problem of ensuring the seismic stability of nuclear power plant pipelines are considered and the consequences of several earthquakes are analyzed. The importance of expert examination of pipeline system designs in order to assess their serviceability under extreme loads of various origins—a necessary condition of ensuring reliable operation of nuclear power plants—is emphasized and a procedure is recommended for carrying out this expert examination. The effect of uncaging and hydraulic shock absorbers used for reducing the dynamic response on the pipeline strength is examined. Experimental investigations of the fatigue failure mechanism carried out in Germany and the United States are reviewed. It is noted that generally speaking, seismic loads must be taken into account at the research and development stage and that a number of

issues still remain unresolved. Comprehensive solution of the seismic stability problem calls for reevaluating existing standards and developing a special manual for designing pipelines for nuclear power plants located in seismically active regions, especially those with a seismicity of force 7 (an anticipated earthquake severity of seven). References 4: 2 Russian, 2 Western.

Design of Filtration-Arresting 'Underground Bulwark' to Ameliorate Consequences of Chernobyl Nuclear Power Plant Accident927F0105A Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 12, Dec 91 pp 21-24

[Article by N.V. Dmitriyev, L.I. Malyshev, B.M. Zarkhin, K.A. Loginov, N.G. Selivanov, Soyuzgidrospetsstroy and Gidrospetsproyekt]

UDC 624.152.612.3

[Abstract] The geological structure of the Chernobyl nuclear power plant site and the danger of groundwater and aquifer contamination are discussed and a system designed for controlling the groundwater conditions on the basis of examinations of hydrological and geological conditions, filtration analyses, and simulation studies is outlined. The system involves the following stages: a filtration-arresting curtain sealing off the site on the east and north, i.e., the most intensive filtration segment on the cooling pond side; cutoff drainage along the site's southern boundary for alleviating or eliminating the transit filtration flow under the site; interceptor drainage along the Pripjat river for intercepting the contaminated groundwater flow entering the river from the site; 16 drainage wells to prevent the groundwater from rising at the site; and drainage downstream from the cooling pond for intercepting the filtration water from the cooling pond. The site layout and underground wall design drawing are shown. The trench for the wall is dug by an SVD-500R-1M digger. The underground bulwark construction involved 1,400 people working around the clock in four 6-hour shifts. Two Italian-made Casagrande trench diggers (S-50 and S-90) were also used. The bentonite grouting mortar preparation procedure is described and the grouting mortar specifications are cited. The operation of domestic and foreign equipment is evaluated and found to be quite adequate for the job. The solidified grouting mortar must have a density of at least 1.7-1.8 t/m³ in order to be efficient. The performance of the prime contractor—the Soyuzgidrospetsstroy—is praised. Figures 3; tables 1.

Seismic Stability of Production Equipment: Ensuring Seismic Stability of Crucial Industrial Facilities927F0043A Moscow *TYAZHELOYE MASHINOSTROYENIYE* in Russian No 8, Aug 91 pp 12-13

[Article by S.P. Kaznovskiy, I.N. Ostretsov, VNIAM]

UDC 699.841.002.5:[621.311.25:621.039]

[Abstract] The features which distinguish seismic protection of crucial industrial installations from that of public buildings, both residential and commercial, and ecologically safe industrial facilities are discussed and it is noted that in the former case it is necessary to ensure seismic resistance of not only the building and structures but also the production equipment, systems, and utilities responsible for safe operation of the facility. It is recognized that except for nuclear power plants (AES), little attention is given to the problem of seismic resistance of production equipment and systems at industrial facilities. The state of seismic protection research and development in the USSR and Japan, France, the United States, and Germany is summarized. Studies carried out by the VNIAM at 18 nuclear power plant generating units with various types of reactors in the USSR, Bulgaria, and Czech and Slovak Federation and the experiments conducted by the ANCO company at U.S. nuclear power plants are outlined. An urgent need to develop and approve regulatory documents for other industries is identified and it is suggested that integrated teams comprising experts in the dynamics of buildings, structures, equipment, and utility lines be included in comprehensive efforts to monitor and safeguard the seismic resistance of crucial industrial facilities. References 1.

Seismic Stability of Production Equipment: Power Valve and Accessory Feasibility Analysis Experience

927F0043B Moscow TYAZHELOYE
MASHINOSTROYENIYE in Russian
No 8, Aug 91 pp 14-16

[Article by I.I. Golenkov, V.I. Yesman, N.Ye. Ripp, VNIAM]

UDC 699.841.002.5:621.311.25:621.039

[Abstract] The importance of valves and accessories for safe operation of nuclear power plants is illustrated using the examples of the Three Mile Island and Chernobyl accidents; in the USSR, generating units with VVER-1000 water-cooled water-moderated power reactors require 21,000 relief, control, stop, and other valves. The PiNAE G-002—86 and OTT—87 standards of seismic stability feasibility are outlined and the program for ensuring nuclear power plant quality control (POKAS) developed on the basis of International Atomic Energy Agency (MAGATE) requirements is summarized; POKAS calls for mandatory checks of seismic stability of generating unit valves and accessories at all stages of their development (from design to startup). Principal feasibility analysis methods are described and the results of analyses carried out at generating units I and II of the Armenian Nuclear Power Plant are presented. A method of calculating the forms and frequencies of natural vibrations and determining the seismic stability category is described. The need for a combined analytical and experimental check of the seismic stability of valves and

accessories installed at nuclear power plants is identified. Figures 2; tables 1; references 5.

Seismic Stability of Production Equipment: Seismic Stability Criteria of Nuclear and Fossil Fuel Power Plant Turbogenerator Sets

927F0043C Moscow TYAZHELOYE
MASHINOSTROYENIYE in Russian
No 8, Aug 91 pp 16-19

[Article by V.V. Kostarev, A.M. Berkovskiy, Scientific Production Association of Central Boiler and Turbine Design Institute]

UDC 699.84:621.165:621.311.25

[Abstract] The shortcomings of the seemingly universal economic criteria of seismic resistance, particularly their inability fully to assess possible social consequences and financial losses resulting from an earthquake, and the inadequacy of the ALAPA method are identified and the expediency of limiting the use of economic criteria is stated. It is shown that there is a special role for searching for simple and reliable designs characterized by minimal costs. The specific features of using the economic criteria for assessing the seismic stability of nuclear and fossil fuel plant turbine-driven units are formulated for a 10^{-2} annual earthquake probability and the design of the base-foundation-turbogenerator set system is analyzed. The seismic risk of the base-foundation-turbogenerator system is calculated and plotted. The consequences of Gazli and Kayrakum earthquakes are estimated. A seismic stability analysis procedure developed at the Scientific Production Association of the Central Boiler and Turbine Design Institute on the basis of the dynamic analysis method (MDA) is outlined and the dependence of the maximum seismic response of the base-foundation-turbogenerator system on the seismic wave type and the type of the mathematical model of the axial bearing is summarized. The procedure makes it possible to obtain a reliability design of the base-foundation-turbogenerator system in a non-linear formulation and develop economically feasible antiseismic measures. Figures 3; tables 2; references 4: 2 Russian, 2 Western.

Seismic Stability of Production Equipment: Seismic Stability Feasibility Analysis of Kozloduy Nuclear Power Plant Turbogenerator Building Pipelines

927F0043D Moscow TYAZHELOYE
MASHINOSTROYENIYE in Russian
No 8, Aug 91 pp 19-20

[Article by S.V. Bazilevskiy, A.A. Sokolov, L.T. Penkova, N.V. Kravchenko, VNIAM, Bulgarian Energo-proyekt NITI, and Bishkek Polytechnic Institute]

UDC 621.311.25:621.039

[Abstract] A comprehensive effort to ensure the seismic stability of the turbogenerator room pipelines at the Kozloduy nuclear power plant prompted by the site seismicity reclassification following several Carpathian earthquakes is outlined. Steam, feedwater, and condensate pipelines are considered; the dynamic analysis and seismic load calculations are made by the finite elements method with localized masses making it possible to take into account shearing strains in rod-type structural members. An analysis leads to recommendations for taking antiseismic measures—primarily using additional supports limiting pipeline displacements and sometimes changing standard assembly designs—as a result of which the maximum level of seismic action stress is lowered five- to tenfold and total stress from a combination of normal operating conditions (NUE) and maximum predicted earthquakes (MRZ) does not exceed the permissible level of 250 MPa. It is stressed that the pipeline design in V-440 generating unit room does not meet seismic resistance standards. References 3.

**Seismic Stability of Production Equipment:
Efficiency Analysis of Seismic Pipeline System
Uncaging**

927F0043E Moscow TYAZHELOYE
MASHINOSTROYENIYE in Russian
No 8, Aug 91 pp 20-22

[Article by V.I. Avdeyev, P.N. Nikitenko, Bishkek Polytechnic Institute]

UDC 699.841.002.5:621.311.25:621.039

[Abstract] A design test of the seismic resistance of pipeline systems for industrial facilities by a routine realizing the dynamic analysis method (MDA) which makes it possible to analyze the behavior of various structures with nonlinear elements under a seismic action is outlined. The dynamic analysis method amounts to representing the design by a system with a finite number of degrees of freedom and performing its dynamic analysis by means of numerical integration of a system of differential equations of motion under kinematic excitation. The routine makes it possible to compute dynamic loads, response displacements, speeds, accelerations, and stresses in structures as well as select the parameters of liquid dampers ensuring a given seismic stability of structures. The results make it possible to conclude that antiseismic devices may be effectively used for extended pipeline systems and reduce the maximum stress in some assemblies by 50%. A comparative analysis of the effect of damper and energy absorber-based uncaging systems on pipelines demonstrates that the response to an external action is lower in pipelines with energy absorbers than that with liquid dampers, making the latter preferable for use in pipelines. Figures 2; tables 3; references 5.

**Seismic Stability of Production Equipment:
Seismic Stability Criteria and Seismic Response
Analysis of High-Power Boilers**

927F0043F Moscow TYAZHELOYE
MASHINOSTROYENIYE in Russian
No 8, Aug 91 pp 22-24

[Article by A.Yu. Shchukin, Scientific Production Association of Central Boiler and Turbine Design Institute]

UDC 624.042.7:534.1

[Abstract] The need for comprehensive assessment of thermal power plant equipment strength and optimal safety margin analysis under the joint effect of power, static, temperature, and dynamic loading factors in seismic-active regions is identified and special emphasis is placed on boilers. Seismic stability criteria are cited, an approximate suspension-type boiler design is presented, boiler uncaging system parameters are determined, and antiseismic boiler designs are summarized. An analysis of seismic stability of suspension boilers carried out at the Scientific Production Association of Central Boiler and Turbine Design Institute demonstrates that when the load-carrying capacity of the structure is taken into account to the utmost and optimum parameters of the frame-boiler system members are selected, is it possible to ensure the seismic stability of high-power boilers at seismic actions of up to 9 on the scale. Figures 5; references 4.

**Selecting Mining of Uranium Ore Beds Using
Bucket-Wheel Excavators**

927F0058A Moscow GORNIY ZHURNAL in Russian
No 5, May 91 pp 47-51

[Article by Ye.A. Kotenko, All-Union Scientific Research and Design Institute of Production Methods]

UDC 622.349.5:622.063.44:621.879.48

[Abstract] The experience of using the selective method in mining thin, gently sloping uranium ore beds by high-output bucket-wheel excavators is summarized and efficient excavation methods as well as stored-program excavator control techniques developed on the basis of theoretical and experimental studies in order to optimize mining procedures are described. Formulas for calculating the method's output as a function of the bucket-wheel dimensions and uranium ore bed parameters are derived. An analysis of the selective mining method demonstrates that in working beds thinner than 2.23 to 2.26 m, bucket-wheel power shovels are more efficient in a lateral stope than in a frontal stope while the reverse is true for ore beds with a thickness of over 2.4 m. ERG-400/1000 or ER-1250 bucket-wheel power shovels used for selective mining have a productivity of 350-380 m³/h and ensure the maximum possible output at the lowest energy outlays, losses, and impoverishment of valuable ore. Figures 3.

Outlook for Using Shape Memory Alloys in Nuclear Power Industry

927F0054A Moscow TYAZHELOYE
MASHINOSTROYENIYE in Russian
No 7, Jul 91 pp 16-19

[Article by F.M. Mitenkov, O.B. Samoylov, I.M. Shchukin, Experimental Design Office of Mechanical Engineering]

UDC 621.039.53

[Abstract] The increasingly stringent requirements being imposed on the safety of nuclear power generating units (YaEU) and nuclear plants (AS) as a whole necessitate the use new materials whose physical and chemical properties differ significantly from those of the hitherto used materials, e.g., alloys with the shape memory effect (EPF). These materials' principal feature is the ability to undergo the so-called thermoelastic martensite transformation (MP); when they are cooled from a high-temperature state, martensite begins to form at a certain temperature; during the heating it eventually turns back into austenite. When a load is applied at the cooling stage, strain develops by the mechanism of oriented growth of martensite crystals which disappear with subsequent heating together with the strain. From the viewpoint of use in structural members of nuclear power generating units with water under pressure as a coolant, titanium-based alloys, e.g., titanium nickelide, are the most preferable since they have a high corrosion resistance and their operating temperature range is very close to that of nuclear power generating units. Specific uses of titanium-based shape memory alloys as Gryofit pipe couplings and Gryocon electric contacts are examined. The use of shape memory alloys for making heat exchanges containing a large number of pipe fittings in the tube plate as well as in self-triggering shut-off devices (SZU) for emergency pipeline sealing in the case of rapid depressurization is considered. Shape memory alloys may also be used to control the actuating temperature of safety valves. It is noted that the use of alloys with the shape memory effect in nuclear engineering is still in the exploratory phase yet there is reason to expect that their applications will expand. Figures 4; references 11.

Prediction of Ground Water Contamination With Radionuclides During Nuclear Power Plant Construction Site Selection

927F0049A Moscow ENERGETICHESKOYE
STROITELSTVO in Russian No 6, Jun 91 pp 12-14

[Article by S.V. Alyutova, All-Union Scientific Research Institute of Water Supply, Sewers, Water Works, and Engineering Hydrology]

UDC

621.311.25:621.039.624.05.539.163.551.49.628.19.001.18

[Abstract] The urgency of environmental protection today is stressed and the main aspects of the methods to

predict the ground water contamination with radioactive nuclides during the nuclear power plant's (AS) life cycle stage of selecting the locality and the specific construction site are considered; the problem is formulated and solved pursuant to the requirements stipulated in the International Atomic Energy Agency (MAGATE) Guidelines. The issue of estimating the spatial position of the contamination source is addressed. A standard hydrogeology exploration program developed by the experts from the All-Union Scientific Research Institute of Water Supply, Sewers, Water Works, and Engineering Hydrology (VNIIVODGEO) for selecting the locality and site for prospective nuclear power plant construction is described; the program was tested for the specific conditions of the Kola nuclear power plant site. The experience of predicting the migration of radioactive nuclides in ground water with the help of this program at one of the Kola cites is considered in detail. A mathematical model of the radioactive contamination process is developed and the filtering boundary value problem is formulated. Forecast data make it possible not only to stipulate protective measures for protecting ground and surface water from contamination but also to create an optimum network of ground water condition monitoring wells which may serve as the basis for eventually developing a ground water monitoring system in the nuclear power plant site region. References 5: 3 Russian; 2 Western.

Procedure for Analyzing Economic Efficiency Indicators of Nuclear Power Plants With Water-Cooled Water-Modulated Power Reactors and High-Power Pressure-Tube Reactors

927F0049B Moscow ENERGETICHESKOYE
STROITELSTVO in Russian No 6, Jun 91 pp 67-70

[Article by Ye.I. Dyakonov, Ye.I. Ignatenko, USSR Ministry of Nuclear Power Industry]

UDC 621.311.25:621.039.620.9.001.2

[Abstract] Energy analysis methods designed in a number of countries for assessing the efficiency of various power industry installations, including nuclear power plants (AS), on the basis of the energy outlays for their development are considered; the purpose of the analysis is to investigate more profoundly the efficiency of the nuclear power plant as a system generating different types of energy. The general premises of a procedure for performing such analyses is formulated and the results of an energy analysis of nuclear power plants with VVER-1000 and RBMK-1000 reactors, a nuclear heat and power plant with a VVER-1000 reactor, and a nuclear heat supply plant with a VVER-500 reactor are presented. Economic and energy indicators of these nuclear plants obtained by the physical and the first and second exergetic methods are summarized and compared. An analysis demonstrates that exergetic methods of energy outlays for the development of nuclear plants

ensure a more objective assessment of the energy efficiency of nuclear plants because they take into account not only the quantity but also the quality of the energy consumed and generated by them; they also make it possible to perform a comparative analysis of various types of nuclear plants on the basis of either energy efficiency indicators or specific outlays since both indicators are determined per unit of usable energy allowing for its quality. Tables 1; references 6: 5 Russian, 1 Western.

Ukrainian Nuclear Security Committee

92P50100A Kiev *NARODNAYA ARMIYA* in Russian
20 Feb 92 p 3

[Ukrainian Prime Minister's Press Service Item: "Can We Sleep Peacefully?"]

[Text] The Ukrainian State Committee for Nuclear and Radiation Safety—that will be the name of the organ that will carry out effective state regulation and monitoring of the safe use of nuclear energy and radiation technologies. By decree of the Ukrainian Cabinet of Ministers it has been created on the basis of the State Committee for Oversight of Work Safety in Atomic Energy.

The new agency will work out principles, norms and regulations for the use, transportation and storage of nuclear materials and radioactive substances, and for the handling of radioactive wastes at all enterprises and organizations, regardless of their subordination or form of ownership, as well as by individual citizens. Scientific work will be carried out to enhance the safety of nuclear energy and radioactive technologies, to solve physical-technical problems of protecting the population from radiation, and so forth. A Main State Inspectorate for the Oversight of Nuclear and Radiation Safety will exist within the State Committee's system.

Nuclear Power Plant Testing. Classification and Analysis of Operator Error in Single-Loop Nuclear Power Plant

927F0047A Minsk *IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK* in Russian Apr-Jun 91 pp 13-17

[Article by A. A. Mikhalevich, S. N. Rymarchik]

UDC 621.039

[Abstract] A classification and analysis of the operator errors which have been observed in testing an experimental model of a single-loop nuclear power plant, resulting in emergency shutdown of the reactor are given. The analysis conducted indicated that the causes of the errors were the same as in other nuclear power plants. In training personnel, attention must be given to the creation of training systems and the requirement that personnel spend sufficient time in the training systems to

acquire the skills necessary to operate the power plant. Exercises should consider the actual daily cycle of human activity. Measures should be included to avoid the passive operator status, make the character of the operators more active, expanding the range of application of "fool proof" systems and devices. Primary attention must be given to professional selection of candidates, which must be continued during training to weed out candidates with insufficient aptitudes. Figures 5, References 9: 8 Russian, 1 Western.

Heating of Nuclear Fuel Specimens by Microwave Radiation in High-Q Resonators

927F0047B Minsk *IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK* in Russian Apr-Jun 91 pp 18-22

[Article by V. S. Vysotskiy, A. A. Posivets, V. P. Reshetin]

UDC 621.370:621.365.5

[Abstract] Studies of the interaction between melted nuclear power plant fuel and structural materials are important for evaluation of the results of serious nuclear power plant accidents. The use of high-Q microwave resonators is an effective means of heating fuel to high temperatures for testing. This article presents theoretical estimates and experimental data on the possibility of significantly increasing the efficiency of the use of microwave radiation energy in such resonators. The studies demonstrate the possibility of effectively heating materials in such resonators. Figures 2, References 5: 3 Russian, 2 Western.

Calculating Natural Fuel Operating Mode in Fast-Neutron Reactors With Varying Fuel Burnup

927F0047C Minsk *IZVESTIYA AKADEMII NAUK BSSR SERIYA FIZIKO-ENERGETICHESKIKH NAUK* in Russian Apr-Jun 91 pp 22-25

[Article by B. V. Mishanin, G. B. Usynin, V. A. Chirkov]

UDC 621.039.526

[Abstract] A previous study has outlined a method for estimating the characteristics of a fast-neutron reactor based on an arbitrary steady fuel mode. This article considers the necessary conditions for applicability of the method and discusses the behavior of breeding characteristics for various burnup depths. It is shown that comparative reactor efficiency can be estimated using the value of isotopes produced. The breeding rate is studied as a function of burnup and chemical processing time. It is shown that as chemical processing time increases optimal fuel burnup also increases. Figure 1, Reference 1: Russian.

The Heat Effect of Power Generation Structures as a Possible Source of Disturbance of Seismotectonic Equilibrium

927F0101A Novosibirsk GEOLOGIYA I GEOFIZIKA in Russian No 8, Aug 91 (manuscript received 11 Jan 91) pp 128-130

[Article by P.Ye. Kotlyar and B.M. Chikov, Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences, Novosibirsk]

UDC 550.34+550.349.2

[Abstract] According to a 1989 publication on the heat effects of power generation facilities, the average flow rate of cooling water per 1,000 MW of reactor capacity amounts to 30 m³/s at thermal electric power plants [TES] and 50 m³ at AES. The heat released by the said plants amounts to 4,500 and 7,300 GJ/h, respectively. The unit capacity at TES or AES is already between 3,000 and 4,000 MW and will soon increase to 6,000 MW. Cooling the condensers at such AES will require about 300 m³/s, which equals the flow rate of an average river. The electric power produced by a power plant is channeled and dispersed over significant areas, whereas the heat energy produced at the same plants (which is often three- to fourfold the amount of electric power produced) is released locally in the immediate vicinity of the AES or state regional power plant [GRES]. USSR Ministry of Power and Electrification standards specify the permissible thermal load in cooling ponds as 300 W/m². Even assuming that 99% of the thermal energy is dissipated in the atmosphere due to evaporation from the surface and turbulent heat transfer and that only 1% is dissipated by heat transfer between the water mass and soil on the bottom of a cooling pond, the anthropogenic heat flux exceeds the permissible heat flux for plateau regions of 0.06 W/m² by a factor of 50. At sites where the hot water is dumped, the permissible level is exceeded by a factor of 500. It may be assumed that enormous amounts of thermal energy (on the order of 10¹⁹ J) released into a localized area for decades will activate seismotectonic processes even in conservative fault systems. One of the most likely mechanisms of such activation is fluid destabilization of faults, which has long been known to hydrogeologists and structural geologists. Disturbance of the natural spatial distribution of the heat flux caused by anthropogenic heat sources may lead to a local inversion of the sign of the geothermal gradient and, consequently, to the occurrence of anthropogenic thermal convection of underground water that in turn destabilizes near-by conservative fault structures. Neither is it possible to exclude the direct filtration of hot fluids from cooling ponds through structural faults in their bottoms. Such filtration losses have been estimated at about 2%, which amounts to about 1 million m³/y. Long-range operation of high-capacity GRES and AES may thus cause significant disturbances in the geodynamic equilibrium and thus activate tectonic processes. Such anthropogenic heat sources must be taken into consideration during geologic engineering explorations

of specific sites to locate new power generation facilities. This is especially important in regions of permafrost. Data exists, for example, on the significant effect of such heat sources near the Bilibino ATETs, which only has a capacity of 48 MW. References 9: 7 Russian, 2 Western.

Calculating the Dose Rate of Outside γ -Irradiation

927F0097A Moscow DOKLADY AKADEMII NAUK SSSR in Russian No 3, 91 (manuscript received 17 May 91) pp 608-611

[Article by R.V. Arutyunyan, L.A. Bolshov, and V.P. Reshetin, Nuclear Power Generation Institute, Belarus Academy of Sciences, Minsk, and Institute for the Problems of Safe Development of Nuclear Power Generation]

UDC 614.876

[Abstract] The authors of this article have proposed what they term a rather simple analytical model for a self-consistent description of 1) the transfer of γ -radiation in soil and 2) the vertical migration of radionuclides. The model is based on the laws governing the change in dose loads over time owing to the sinking of radioactive matter in soil. In an initial approximation, the authors describe the dynamics of the sinking of radioactive matter in a soil layer within the framework of a diffusion model where the diffusion and filtration coefficients of each radionuclide in either soluble or insoluble form are selected from data obtained by experimentation. The model on which the method is based also assumes that the process of absorption and scattering of γ -radiation that occurs in a soil layer is very different from primary radiation processes. It is also assumed that the radiation detector being used is located at soil level. The radiation scattered in the soil and secondary radiation are given consideration by means of an accumulation factor that depends on the γ -quantum energy, the nuclear profile of the soil, and the distance to the radiator. An additional cofactor is also introduced to allow for the barrier nature of soil. The proposed dose rate calculation method has also been designed to give consideration to the fact that the filtration rate and diffusion coefficient of γ -active radionuclides may vary widely depending on the chemical composition of the soil and the form in which the radionuclides enter the soil. In the case of soddy podzolic soil and soil suspensions, the diffusion and filtration rate coefficients for the rapidly migrating component of ¹³⁷Cs amount to 1.0 cm²/y and about 1 cm/y, respectively. The diffusion and filtration rate coefficients of the slowly migrating component of ¹³⁷Cs are much lower. In the case of heavy clay soils, vertical migration of radionuclides is due mainly to diffusion. For the rapidly migrating component of ¹³⁷Cs, $D \approx 1$ cm²/y, and $W \approx 0.1$ cm/y. The ratio of the quantities of rapidly and slowly migrating radionuclide components, moreover, is largely dependent on the type of radionuclide and the form in which it is precipitated. The amount of slowly migrating component in ¹³⁷Cs is somewhere in the range

from 40 to 60%. Thus, the relative reduction in outside irradiation dose rate in a period of 30 to 50 years due to the screening of γ -radiation by a soil layer is thus somewhere between a factor of 2 and 3 depending on the type of soil and form of the radionuclide. Figure 1; references 8 (Russian).

Solving Ecological Problems When Developing New Designs for Safer AES With VVER Reactors

927F0096A Moscow TEPLOENERGETIKA in Russian
No 12, Dec 91 pp 21-26

[Article by L.M. Voronin, doctor of technical sciences, and V.M. Berkovich, engineer, All-Union Scientific Research Institute of Nuclear Power Plants and Atomenergoprojekt]

UDC 621.311.25:621.039

[Abstract] The more than 200 reactor-years of experience that have been accumulated in the operation of nuclear power plants with VVER reactors confirms that such plants are reliable and stable and can have high technical and economic indicators. This is especially true in the case of plants with VVER-1000 reactors, at which emissions of inert radioactive gases, iodine 131, and long-lived nuclides are only a third to a half the permissible levels. Vent stack emissions and dose loads to plant personnel are also well below established limits. Since the Chernobyl accident, measures have been put in place to ensure that all new plants and reactors are safer than their predecessors and that their effects on the ecology are carefully examined by experts. Working within the framework of the state scientific-technical program entitled Ecologically Pure Power Generation, the institute Atomenergoprojekt is serving as the lead organization in developing a new-generation nuclear power plant with VVER-1000 reactors. The design of the new plant, called the AES-92, incorporates 16 new design decisions. The following are among them: a four-loop VVER-1000 reactor unit with vertical steam generators with a capacity of 1,000-1,110 MWe; a rated coolant pressure of 16 MPa in the primary loop, rated temperature at the reactor outlet of 325°C, and working steam pressure of 7.0 to 7.5 MPa in the secondary loop; a reactor life of 60 years; a depth of fuel burnup in the reactor of 40-50 MWd/kg with three or four refuelings per run; a core power reactivity coefficient that remains negative in all operating modes; a newly designed main circulating pump featuring a water lubricant and without coolant leakage through the pump seals; a closed coolant purging and cleaning system; use of the principle of "deep protection," which is based on the use of multilevel barriers along the route followed by fission products as they are released into the environment; measures to ensure that the probability of significant emission of radioactive waste into the atmosphere will be below 10^{-7} per reactor per year; the use of a passive heat abstraction system that will operate in all modes and during all design accidents to guarantee the removal of heat from

the reactor core when the active cooling systems and/or all power sources are lost; a system for emergency dumping of the medium from the jacket and a system to trap and retain fused fuel; and a probability of serious damage or fusion of the fuel in the core not exceeding 10^{-6} per reactor per year. The planned emissions from the AES-92 will be far below permissible daily limits; 2.1×10^{-4} Ci of radioactive iodine will likely be emitted daily (versus the established limit for a four unit plant of 2,000 Ci/d), and the planned emission of long-lived radionuclides is 2.3×10^{-4} (versus the 0.06 Ci/d established as the maximum permissible limit). The design of the AES-92 also provides for automated monitoring of radiation conditions over a wide area, as well as for preservation of the landscape surrounding the plant. The introduction of new heat and water supply systems that are much more progressive and safer than those currently used at existing nuclear and thermal power plants will make it possible to reduce by 2,500 hectares the amount of land that must be confiscated around each four-unit AES with a capacity of 4,000 MWe. Efforts are also under way to achieve similar safety improvements in smaller reactors with capacities of 500 to 600 MW. Figures 2, tables 2.

Formulation of the Problem of Diagnosing the Processes and Equipment of the NSSS of a BN-600 Unit

927F0096B Moscow TEPLOENERGETIKA in Russian
No 12, Dec 91 pp 29-33

[Article by A.G. Sheynkman, candidate of technical sciences, and V.D. Kozyrev, engineer, Beloyarsk AES]

UDC 621.039.526:51

[Abstract] Diagnosing a nuclear steam supply system (NSSS) requires a systems approach to selecting the objects, methods, and means to be used in diagnosing the processes and equipment included in the system. The BN-600 unit at the Beloyarsk AES was examined to determine the necessity, feasibility, and possibility of creating a diagnosis system based on the equipment existing at the Beloyarsk plant. In the first stage of this assessment process, specialists worked to establish their priorities and the approaches that they would use in order to be able to have the new diagnosis system encompass the widest range of basic and auxiliary equipment and processes possible. The physical processes occurring when equipment flaws become evident were analyzed. Flowcharts were developed that outline the specific processes and equipment that would need to be examined in diagnosing the following: the reactor core and the components of the primary loop (i.e., components located both inside and outside the vessel); the emergency protection channels and channels to protect and block equipment; the information channels of the automated technological process control system; the secondary loop and steam generator; and the thermomechanical equipment of the tertiary coolant loop. Next,

separate analyses were conducted to determine the hardware, software, and algorithms required to create a comprehensive diagnosis system. These analyses established that for the most part, the plant's existing standard diagnostic equipment would be adequate for the new monitoring system. The hardware of the plant's existing experimental testing and measuring equipment system would only be required for use in the following: a system for vibrodiagnosis of rotating mechanisms (which requires a system with improved characteristics); a system to diagnose the status of the coolant (sodium) of the primary and secondary loops (which requires sensors to measure the concentration of hydrogen, helium, nitrogen, and carbon, etc., in the sodium and argon); and a system for noise diagnosis (which would require low-inertia sensors and systems to measure rapidly occurring processes). The software assessment revealed that the Kompleks-Uran information computer system, YeS-1036, and peripheral computers are also needed. The plant's existing standard data processing and display software were found to be adequate; however, the plant currently is virtually without the software, algorithms, and diagnostic criteria required to recognize anomalies in processes and equipment at the plant. Specifically, use of the Kompleks-Uran information computer system requires the creation of new algorithms and software specifically geared toward discovering operational anomalies. The analysis also revealed that the new diagnosis system should be based on a combination of four diagnostic methods: the method of statistical characteristics, noise diagnosis, the method of dynamic characteristics, and the expert systems method. A technical and economic analysis of the projected savings resulting from installation of an NSSS diagnosis system such as that described herein indicated that such a system would result in a savings between 2 and 2.5 million rubles per year per reactor unit. Fifteen diagnostic subsystems of the integrated system are currently in operation at the Beloyarsk AES. Figures 6; references 5 (Russian).

An Automated Subsystem To Monitor and Control the Water-Chemical Regimen of the Secondary Loop of an AES With a VVER Based on the Kompleks-Titan-2 Control Computer Complex

927F0096C Moscow *TEPLOENERGETIKA in Russian*
No 12, Dec 91 pp 33-38

[Article by V.A. Mamet and P.N. Nazarenko, candidates of technical sciences, and N.G. Kiselev, V.Ya. Kozlov, M.V. Fedoseyev, and N.D. Tishchenko, engineers, All-Union Scientific Research Institute of Nuclear Power Plants and Zaporozhye AES]

UDC 621.311.25:621.039.62.5

[Abstract] An automated system to monitor and control the water-chemical regimen of the secondary loop of a nuclear power plant with VVER reactors should include three interconnected subsystems: an information-measuring subsystem, a computer subsystem, and a control subsystem. All nuclear power plants with VVER reactors are currently equipped with an automated chemical monitoring system that marks the first step in the creation of an information-measuring system functioning as a component of an automated system to monitor and control a water-chemical regimen. These systems are not standardized with one another. Rather, they differ with respect to the amount of input information (from 12 to 40 parameters are monitored in each) and with respect to their auxiliary devices, measuring equipment, and computer technology. At present, water-chemical regimen monitoring systems are designed to state the fact that the regimen has been disturbed rather than to diagnose its condition and forecast any one of a number of problems that may develop. Specialists at the Zaporozhye AES and the All-Union Scientific Research Institute of Nuclear Power Plants have taken the first steps toward raising the plant's existing automatic chemical monitoring system to the level of an information-measuring system. Specifically, they have created and introduced an automated water-chemical regimen monitoring and control system based on the Kompleks-Titan-2 computer system. The new monitoring system is set up to monitor the secondary loops of the plant's five existing units as well as the following auxiliary equipment: the drain tank, the A and B line boilers, the generator stator's cooling system, the active water treatment equipment, and the chemical water treatment equipment. The new monitoring system is designed to accept a virtually unlimited amount of input information and permits the creation of files or arrays of the following: 12 measurements of specified parameters per hour; the ongoing value of a parameter n ; $(n - 1)$ polling parameters; $(n - 2)$ polling parameters; and three arrays of statistical calculations per shift, day, or month. The arrays n , $(n - 1)$, and $(n - 2)$ make it possible for the dynamics of the change in specified parameters during the last three polls to be displayed at the operator-technologist's workstation. The new monitoring system is also equipped with an algorithm that automatically gives operator-technologists advice regarding correcting any existing or potential problems detected in the water-chemistry regimen. Print forms and programs have been designed for three protocols (shift, day, month). The experience gained in operating the subsystem will eventually be used to optimize laboratory and automated monitoring of the water-chemical regimen in the secondary loop of plants with VVER reactors. Figures 3, tables 5.

Problems of Rebuilding Razdan Regional Power Plant After Earthquake927F0050A Moscow *ENERGETICHESKOYE STROITELSTVO* in Russian No 6, Jun 91 pp 31-33

[Article by I.N. Alkhovskiy, Rostov Branch of Thermal Electric Power Plant Design Institute]

UDC 550.34.621.311.625.173

[Abstract] The problem of rebuilding the Razdan state regional power plant (GRES) located in the intermontane syncline on the Marmarik river terrace in Armenia, 42 km northeast of Yerevan and 17 km west of the Lake Sevan at an altitude of 1,715-1,730 m above sea level, is addressed. The characteristics of the site's geological region are summarized. The power plant consists of two parts—a heat and power supply plant and an electric power generating plant. The seismic features of the power plant and its uncaging structures are described. The extent of damage inflicted on the power plant by the earthquake on 7 December 1988 which registered 7.2 on the MSK-64 scale is described in detail and the volume of reconstruction effort and the specific reconstruction and reinforcement procedures determined on the basis of engineering analyses are outlined. When rebuilt, the Razdan regional power plant should be able to withstand earthquakes of up to force-9.

'Turboatom' Scientific Production Association Is Developing and Upgrading Turbine Plants for Thermal Power Plants927F0051A Moscow *ENERGETIK* in Russian No 7, Jul 91 pp 5-8

[Article by M.A. Virchenko, Yu.F. Kosyak, L.A. Zurbabin, V.P. Sunikhin, B.A. Arkadyev, V.N. Galatsan, V.A. Paley, A.S. Burakov, V.I. Muravyev, Kharkov Turbine Plant]

[Abstract] The virtual cessation of progress in the power industry in the USSR in recent years is discussed and the needs and principal trends in the development of the industry are identified; emphasis is placed on upgrading obsolete coal or fuel oil burning 160, 300, and 500 MW turbines, speeding up the development of ecologically safer and more economical steam-gas turbines, and improving the turbine design by using the results of research and design efforts. The specific steps taken in each of the above development areas by various design offices, R&D organizations, scientific production associations, and plants are described in detail and the operating experience of new turbine plants and units is summarized. The work of various entities, especially the Turboatom Scientific Production Association, in the framework of the country's Energy program is discussed; it is expected that starting with 1993, the company will start producing turbines for operation without a deaerator. Figures 2.

A Comprehensive Investigation of Steel Corrosion Products Formed in Straight-Through Demineralized Water During Polarization and Oxygen Passivation927F0094A Moscow *ELEKTRICHESKIYE STANTSII* in Russian No 12, Dec 91 pp 67-73

[Article by N.V. Ivanova, engineer, and M.Ye. Shitsman, doctor of technical sciences, Power Engineering Institute imeni G.M. Krzhizhanovskiy]

UDC 621.182.1:620.193.4.001.5

[Abstract] The authors of the study reported herein used three independent methods to perform a comprehensive study of the steel corrosion products formed in a straight-through flow of demineralized water during polarization and oxygen passivation. The three methods used were 1) gravimetric determination of the steel specimens' corrosion-induced mass losses; 2) determination of the corrosion products in the surface layers of the same specimens by electronography; and 3) determination of the said products by Auger electron spectroscopy. Two series of experiments were conducted. In the first series, the corrosion potential (E_c) was varied by blasting the steel specimens with oxygen in O_2 concentration ranging from 5 to 40,000 $\mu\text{g/kg}$ with no polarization from an external current source. In the second series of experiments, the polarization potential (E_p) was varied by anodic polarization of the electrode from an electromotive force source in water with an O_2 concentration between 0 and 5 $\mu\text{g/kg}$. The studies performed established that when a single electrode is blasted with oxygen, E_c increases to +0.3V, while the corrosion rate decreases to $Q = 0.02 \text{ g/(m}^2 \times \text{h)}$. The very same change in potential, achieved by anodic polarization from an external current source in deaerated demineralized water, was found to have the opposite result. In other words, it resulted in a significant increase in Q : when $E_p = 0.3 \text{ V}$, Q increases to $1 \text{ g/(m}^2 \times \text{h)}$. The studies performed established the inadequacy of physicochemical effects given identical values of E_c and E_p values in corrosion tests with a straight-through flow of demineralized water. The electronography and Auger electron spectroscopy analyses of the oxide layers confirmed the different mechanisms of the processes occurring when $E_c = E_p = 0.3 \text{ V}$. In the case of blasting with oxygen, a passive $\gamma\text{-Fe}_2\text{O}_3$ phase begins to form within the first 6.5 hours of exposure. In the case of the effect of an anodic current, the corrosion process entails a state of formation of a solid oxygen solution in the $\alpha\text{-Fe}$ phase. Its presence causes the oxide layer to acquire an unstable island structure that is characteristic of pitting formation processes. Analysis of the mechanism of the passivation process occurring during hot water-oxygen treatment established that after acid cleaning of the surfaces, treatment at a reduced O_2 concentration results in the formation of nonpassivating oxide layers. Thin (up to 600 angstroms) passivating oxide films were only discovered to form during hot water-oxygen treatment when significant oxygen concentrations were present. Figures 5, references 14: 7 Russian, 7 Western.

Calculating Gas Turbine Engine Parts' Coefficient of Strengthening by Balls in Ultrasonic Field

927F0072A Kiev *PROBLEMY PROCHNOSTI*
in Russian No 8(266), Aug 91 pp 78-80

[Article by V.K. Yatsenko, Zaporozhye]

UDC 621.787.4

[Abstract] The similarity theory and dimensionality analysis are used in examining the physical factors which affect the behavior of the coefficient of strengthening of gas turbine engine (GTD) parts strengthened by balls in an ultrasonic field. The results of an examination of the

endurance strength of gas turbine engine parts and blades strengthened by balls in an ultrasonic field make it possible to identify the principal factors of the strengthening process: the ball diameter, the ball mass, the ball's velocity of collision with the strengthened part, the dynamic hardness (the Brinell hardness number), the strengthening duration, the volume of the chamber with the balls, the ultimate strength and yield strength of the strengthened materials, and the relative gradient of the first principal stress in the part's working cross section. A model of the strengthening coefficient is derived, making it possible to optimize the strengthening conditions and determine the safety margin at the design stage. Tables 3; references 4.

The Contact Explosion of a Cylindrical Explosive Charge Buried in Soft Soil

927F0093A Moscow IZVESTIYA AKADEMII NAUK
SSSR: MEKHANIKA TVERDOGO TELA in Russian
No 6, Nov-Dec 91 (manuscript received 10 Jul 90)
pp 176-182

[Article by A.V. Krymskiy and A.S. Udalov, Moscow]

UDC 539.215

[Abstract] Most previous studies of explosions of explosive charges have not given consideration to the slip of the detonation products relative to the medium surrounding the charge, and most have used the condition of adhesion on the contact boundary between the two media. The authors of the study reported herein, on the other hand, have taken the phenomenon of slippage into account in their examination of the contact explosion of a cylindrical charge of an explosive buried in soft soil. Specifically, they assumed that the area occupied by the explosive charge had a constant density of 2 g/cm^3 under an initial pressure of 100 Kbar. For the explosion products, they used the model of an ideal gas with an adiabatic exponent of 3. The problem was solved in Lagrangian coordinates. To describe the slip occurring at the contact boundary between the two media, the authors doubled the nodes of a finite-difference grid. A four-step procedure was used for numerical realization

of the slippage. The first step entailed preliminary calculation of the motion of the gas nodes throughout the solid medium. Second, the velocity and displacement of the nodes of the solid medium's boundary were calculated. The third step consisted of refining the positions of the gas nodes at the boundary. The force and other characteristics of the gas cells and soil were determined in the fourth stage. By giving consideration to the slip of the explosion products at the boundary where the two media made contact, the authors were able to perform numerical calculations for rather large time values. They found a numerical solution for the case of an explosive charge with a radius of 1.05 m and height of 0.9 m. The boundary between the charge and soil was found to be a discontinuity surface that initially decayed into a detonation-product rarefaction wave, a contact discontinuity, and a compressional wave of particles of the soft soil. As a result of their examination of the effect of a free surface on the stress-strained state of the soil, the authors calculated that a deeply buried charge initiating a shock wave such as that propagated along the symmetry axis during the contact explosion of an explosive charge has an energy efficiency coefficient of 0.23 (assuming loamy soil with a density of 1.7 g/cm^3 and a moisture content of 20 to 22%). They also derived relationships between the maximum velocities close to the free surface and on the symmetry axis of the compressional wave, as well as between the peak values of the stresses in both regions. Figures 6; references 9 (Russian).

On Criteria Approximation in Dynamic Synthesis Problems of Manipulator Robots

927F0070A Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 320 No 1, Sep-Oct 91 pp 58-61

[Article by A.G. Perevozchikov, V.V. Fedorov, Moscow State University imeni M.V. Lomonosov]

UDC 519.71

[Abstract] Known dynamic quality criteria of all-purpose manipulator robots are considered and it is shown that the preference relation pattern defined by criteria may be approximated by the comparison relations of the robots' certain simple characteristics. Examples of dynamic criteria, such as motion control quality criteria, are cited and the technical characteristics of manipulator robots are examined. Examples of the simplest three-link robot systems are considered in orthogonal, cylindrical, and spherical systems of coordinates. The criteria facilitate dynamic synthesis of the balancing axes for all possible configurational systems; an addition of directional axes does not significantly change the resulting design. References 9.

Operational Durability of Carbon and Vanadium Steel Wheels in Passenger Trains

927F0053B Moscow VESTINIK VSESOYUZNOGO NAUCHNO-ISSLEDOVATELSKOGO INSTITUTA ZHELEZNODOROZHNOGO TRANSPORTA in Russian No 5, Jul-Aug 91 pp 32-36

UDC 629.4.027.4:669.14.018.29

[Article by L.M. Shkolnik, A.V. Fofanova, D.P. Markov, I.M. Prokhorenko, V.N. Tsyurenko, V.V. Tyazhelnikov, L.A. Usova]

[Abstract] The increasingly stringent requirements being imposed on the quality, operational reliability, and durability of railroad car wheel and the improvements in the ultimate strength, hardness, and wear resistance of wheel flanges due to changes in the chemical composition and the use of advanced heat treatment are discussed. Wheel vulnerability to individual types of defects is analyzed and the outcome of experimental tests of pilot wheels under passenger train cars is summarized; the feasibility of introducing a new brand of wheel steel is examined. To this end, the effect of alloying carbon steel with vanadium on the operational durability and performance of railroad wheels is analyzed. The mechanical properties of pilot wheels from quality 3 steel are compared to those of mass-produced quality 2 wheels. The results of operational tests conducted between Moscow and Vladivostok—a rail route characterized by very diverse climatic conditions and track profiles and radii—demonstrate that wheels from quality 3 vanadium steel with an increased carbon content have a 24-34% higher wear resistance according to GOST 10791—81 than those from quality 2 steel. Test data

make it possible to recommend that GOST 10791—89 for solid wheels from quality 3 vanadium steel with an elevated carbon concentration for cars with cast iron brake blocks as well as disc brakes and electromagnetic brakes be amended and vanadium microalloying be used for making wheels. Figures 6; tables 4; references 3.

Mobile Unit for Opening and Closing Railroad Gondola Car Hatches

927F0052A Moscow MEKHANIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 6, Jun 91 pp 17-18

[Article by N.Ye. Smirnyagin, Yu.A. Antonov]

UDC 65.011.54

[Abstract] The need to open and close gondola car hatches frequently in order to load or unload loose materials at storage facilities as well as clean the gondola cars is identified and a mobile unit developed at the chrome-iron ore storage depot of the "Magnezit" Ore Dressing Combine is described. The unit for safely opening and closing the gondola hatches (replacing an earlier U-shaped design traveling on crane runway girders) consists of a cantilever bridge whose two running wheels—one drive and one driven—travel on crane rails mounted on the existing crane runway girders. The unit has a 380 V power supply system and travels at a 1 m/s speed. It is serviced by two workers. The operating procedure is described in detail. Implementation of the cantilever bridge-type mobile unit for closing and opening gondola car hatches created safe working conditions for opening the hatches and mechanized the hatch closing operation. Figures 1.

New Methods of Hardening Rail Tie Plates

927F0053C Moscow VESTINIK VSESOYUZNOGO NAUCHNO-ISSLEDOVATELSKOGO INSTITUTA ZHELEZNODOROZHNOGO TRANSPORTA in Russian No 5, Jul-Aug 91 pp 37-39

[Article by V.M. Fedin, L.P. Strok, V.P. Devyatkin, Ye.V. Boldyreva]

UDC 621.785.545

[Abstract] Failures of KB-65 rail tie plates—one of the most common yet insufficiently reliable fastening parts—made from low-carbon steel 3 and the issue of increasing their reliability and longevity are discussed. Hardening of tie plates for KB-65 rails (GOST 16277—78) is examined in an experimental unit developed at the VNIIZhT by heating them at a 4-6°C/min rate in the phase transition region and cooling in a water flow delivered at a 0.2 MPa pressure without tempering. The ultimate strength, yield point, elongation, and reduction of area at fracture are investigated in cylindrical samples cut from tie plates after hardening according to GOST 1497—73. A study of the hardness distribution in the tie

plate cross section reveals a gradient of properties: hardness reaches 380 HV in the surface layer but dips to 220 HV at the core. Cyclical durability tests with three-point bending are used as the principal criterion for assessing the performance of hardened tie plates; the tie plate microstructure after hardening is studied under a Tesla-540 electron microscope in order to establish the hardening characteristics. Test data show that hardening improves the strength of tie plate material by 25-50% and develops residual compressive stresses in the hardened surface layer, and make it possible to suggest the use of hardening of low-carbon steel 3 tie plates. This increase in the material strength and the resulting improvement in the residual stress profile make it possible to increase the cyclical tie plate durability by 1.3-1.5 times. Figures 4; tables 1; references 3.

Investigation of R65 Rail Reliability Using Weibull's Distribution

927F0053A Moscow VESTINIK VSESOYUZNOGO NAUCHNO-ISSLEDOVATELSKOGO INSTITUTA ZHELEZNODOROZHNOGO TRANSPORTA in Russian No 5, Jul-Aug 91 pp 24-27

[Article by A.V. Gavrilencov, L.G. Krysanov]

UDC 625.143:62-192

[Abstract] The need to replace 13-14 thousand kilometers of R65 rails during annual overhauls and the urgency of the problem of investigating the serviceability and reliability of rails are recognized. Two types of factors affecting the rail reliability and performance are considered: the quality of the metallurgical materials and processes and traffic parameters. The effect of the freight traffic carried over the rails and the freight traffic density on the reliability indicators of R65 rails—both hardened and not hardened by heat treatment—is examined on the assumption that the failure density distribution follows Weibull's law. The following indicators are analyzed: failure rate, failure density distribution, cumulative failure rate, failure probability, and survival probability. Statistical data on the cumulative rail withdrawal in

1982-1984 and rail failures on 20-25 railroads with the heaviest traffic are used for illustration. An analysis of rail reliability indicators under network operation conditions makes it possible to identify the following main factors affecting the rail reliability—heat treatment, traffic density, and traffic volume—whereby the rail failure rate follows Weibull's law; for some practical applications, it is expedient to determine the cumulative failure rate as well as the failure rate, failure distribution density, survival probability, and mean traffic volume to failure. Heat treatment substantially improves all reliability indicators under today's operating conditions. Figures 3; tables 3; references 3.

New Sections for Car Building and Their Utilization Efficiency

927F0055A Moscow TYAZHELOYE MASHINOSTROYENIYE in Russian No 7, Jul 91 pp 20-22

[Article by S.Ye. Odinkov, A.I. Shakhparonov, All-Union Scientific Research Institute of Railroad Car Building]

UDC 669.1.003.13:629.4

[Abstract] The need to define the range of new cold roll-formed and hot rolled economical sections for the railroad car building industry and measure the economic efficiency of their use is identified; the effort carried out by the All-Union Scientific Research Institute of Railroad Car Building (VNIIV) together with railroad car building plants to improve existing and develop new economical cold roll-formed and hot-rolled sections for 1990-1995 and develop a range of new sections is described; the new assortment consists of 24 types of sections: 21 cold roll-formed and 3 hot rolled. The specific uses of the new sections at various car making plants are outlined in detail. The total metal savings from implementing the new sections in the industry is 2,327 t while the economic effect reaches 6,411 rubles. The problems experienced by the car builders in trying to implement new products due to the obstacles placed by the USSR Metallurgy Ministry are summarized.

IT-5 Automated Unit for Measuring Thermal Conductivity of Nonmetallic Materials

927F0073B Moscow IZMERITELNAYA TEKHNIKA
in Russian No 6, Jun 91 pp 43-45

[Article by T.G. Grishchenko, P.V. Katsurin, L.V. Seregina]

UDC 536.2.083:681.5

[Abstract] The urgency of improving the devices for measuring thermal characteristics of various materials despite the availability of new analysis and prediction methods is noted and the shortcomings of existing instruments are identified. A new IT-5 thermal conductivity meter consisting of a thermal unit with sensors, an electronic sensor data collection and processing unit, and a standard liquid thermostat is described and the measurement procedure is outlined in detail. The results of an experimental examination of the dynamic response of the IT-5 in measuring the thermal conductivity of various samples are presented; for a material with a thermal conductivity within a 0.2-1.5 W/(m x °K) range, readings are obtained at a (100+/-1%) level in 15-20 min. The results of an investigation of the device's metrological characteristics are cited. The IT-5 has passed state acceptance tests at the Energy Savings Institute at the USSR Academy of Sciences and is recommended for commercial production for measuring thermal conductivity in the 0.03-5.0 W/(m x °K) range at a 220-360K temperature. IT-5 is recorded under No. 12085-89 at the USSR State Registry of Measures and Instruments. Figures 2; references 6.

Low-Frequency Sound Receiver for Operation Under Natural Conditions

927F0073C Moscow IZMERITELNAYA TEKHNIKA
in Russian No 6, Jun 91 pp 51-52

[Article by V.I. Albul, A.F. Kurchanov, A.S. Rypalev]

UDC 534.612.089.6

[Abstract] The need for increasing the accuracy of devices for directly measuring the sound pressure in aqueous media is stressed and a low-frequency receiver equipped with a means of absolute calibration which can be performed in the field and at a considerable depth is described. The device is a small chamber with rigid walls housing a hydrophone. The calibration procedure is outlined and the components of the sound receiver calibration error are examined using the example of one device with walls made from the VT1-0 titanium alloy. The device's fundamental error is found to be equal to 2.8%. The effect of possible ambient temperature and hydrostatic pressure variations on the measurement accuracy is evaluated. Full-scale tests carried out in the Atlantic Ocean at a 3,360 m depth reveal that the sound receiver has a mean sensitivity of 165 μ V/Pa; compared to a lab sensitivity of 159 μ V/Pa, this represents a 3.9%

discrepancy. Considering the severity of the experimental conditions, the convergence of analytical and experimental results may be regarded as good. Figures 2; references 4.

Electron Beam Probing of Charged Particle Beams With Rectangular Cross Section

927F0073D Moscow IZMERITELNAYA TEKHNIKA
in Russian No 6, Jun 91 pp 53-54

[Article by A.I. Shitakov, V.N. Azarov, I.P. Vykhvat]

UDC 539.188.089.5

[Abstract] The use of square and rectangular charged particle beams shaped by systems with two mutually perpendicular planes of symmetry, e.g., slit diaphragms, quadrupole lenses, etc., in which the half-breadth is comparable to half-width, so the effect of the space charge near the flux width fringes is commensurate with the effect near the flux breadth fringes is discussed. A charged particle beam with a rectangular cross section is considered and the assumptions made for determining the probing electron beam scattering parameters are outlined. The electric field strength inside and outside the round electron beam is described by a system of equations and the total beam current is calculated. An analysis shows that the rectangular charged particle beam can be regarded as a beam whose boundary is described by an eighth-order curve. This approach to the issue of electron beam probing is more general than known methods and makes it possible to develop probing models for beams with various cross sections. Figures 2; references 2.

Design Principles of Multifunction Charged Particle Beam Transducers Based on Electron Beam Probing Methods

927F0073E Moscow IZMERITELNAYA TEKHNIKA
in Russian No 6, Jun 91 pp 54-56

[Article by V.N. Azarov]

UDC 539.188.087.92

[Abstract] The use of ancillary charged particle beams to obtain data on the structure and parameters of a charged particle beam under study without distorting the latter whereby the particles of the probing beam interact with the intrinsic electric and magnetic fields of the target beam is discussed. The probing particle (i.e., electron) equation of motion is derived assuming that both beam particles travel in a vacuum in the absence of external fields. Scattering functions are calculated, tabulated, and plotted for technological beams with round and elliptical cross sections and with Gaussian, truncated Gaussian, and uniform current density distributions. As a result, electron beam probing methods are tentatively divided into diagnosing "thick" beams with a diameter of 1 mm or more by a thin probing beam and diagnosing "thin"

beams with a diameter of 1 mm or less by a probing beams whose transverse dimension is greater than that of the technological beam. The probing beam current density distribution in the cross section is the diagnostic variable before and during the interaction. Three models are considered and checked by comparing the numerical values of deflection angles to the values obtained by solving the probing electron's equation of motion. The maximum deviation does not exceed 5%. Numerical simulation and experiments show that electron beam probing methods make it possible to realize noncontact multifunction transducers of charged particle beams for a wide range of currents, energies, and dimensions. Figures 2; references 2.

Algorithmic Error Reduction of Beam Parameter Measurements by Electron Beam Probing Method

927F0073F Moscow IZMERITELNAYA TEKNIKA
in Russian No 6, Jun 91 pp 57-59

[Article by V.A. Agibalov, V.P. Shestak]

UDC 539.188.089.5.088

[Abstract] The shortcomings of transducers with fixed transfer functions are discussed and the need to develop standardized multifunction transducers (MFIP) which combine the features of individual transducers (IP) each capable of measuring one of almost two dozen beam parameters is identified. This would simplify the development of the measurement data processing system as a whole and transducer design, expand the transducers' dynamic range, and decrease the errors of individual measurements. The resulting multifunction transducers should have a multiparameter transfer function making it possible successively to obtain a set of known transfer functions for a given change in individual parameters. A block diagram describing the operation of an electron beam multifunction transducer for measuring the parameters of charged particle beams is presented. It is shown that if a multifunction transducer is used for measuring multiparameter targets, it is possible to lower the measurement error of individual target parameters by selecting the optimum measurement algorithm or optimum transfer function. To this end, optimization may be conducted for a group of, or individual, transducer parameters which determine the transfer function; consequently, the transducers used for measuring multiparameter target must themselves be multiparametric. Figures 2; references 5.

Device for Measuring Rigid Body Inertia Tensor

927F0073A Moscow IZMERITELNAYA TEKNIKA
in Russian No 6, Jun 91 pp 37-39

[Article by Ye.V. Buyanov]

UDC 608.3:531.751.001.66

[Abstract] The problem of determining the tensor of inertia of rigid bodies which arises in analyzing the

motion of various mechanical entities, such as airplanes and space vehicles, is addressed and a new device which makes it possible to measure the tensors of inertia of bodies with a random configuration is briefly described. The device has a low inertia of its own and is highly efficient due to eliminating the operation of center-of-gravity location of the rigid body. A design drawing of the tensor measuring device is presented and the purpose and operation of its components are summarized. Equations are derived for calculating the tensor of inertia on a computer. The device maintains the advantages of similar systems in that it is capable of locating the center of gravity and aligning the system and itself relative to the sensitive axis but is more versatile since it is capable of measuring the tensor of inertia of bodies with an arbitrary configuration regardless of the availability of datum surfaces. It also makes it possible to increase the measurement accuracy and is highly efficient. Its efficiency may be increased further by determining the moment of inertia of the device itself analytically rather than experimentally. Figures 1; references 3.

Thin Film Temperature-Sensitive Resistors With Improved Accuracy and Negative Temperature Coefficient of Resistance

927F0064B Moscow PRIBORY I SISTEMY
UPRAVLENIYA in Russian No 5, May 91 pp 29-30

[Article by V.N. Novikov, A.Ye. Pronkina]

UDC 621.316.825.3-416

[Abstract] The use of temperature-sensitive resistors (TR) in various types of transducers and the problem of using industrial temperature-sensitive resistors in consumer appliances due to the wide spread of their resistance and temperature coefficient of resistance are discussed. It is shown that the use of temperature-sensitive resistors for this purpose largely depends on the possibility of reducing their parameter spread, increasing their stability and service life, and ensuring their interchangeability. These requirements are met in thin film temperature-sensitive resistors with a laser resistance trimming which make it possible to lower the resistance spread from 5-20% to 1-2%. The temperature-sensitive resistors are developed on the basis of thin layers of semiconductor materials made from mixed oxides of transition metals. The new temperature-sensitive resistors are stable in operation and have an actual resistance variation of no more than 2% during 8,000 h of operation at the maximum working temperature of 125°C. The new temperature-sensitive resistors have a negative temperature coefficient of resistance with a spread of 2-5%, a thermal time constant of ≤ 15 , and a power dissipation of 25 μ W. Their operating temperature range is -60 to +125°C. The resistors may be used for temperature measurement and control and for temperature

compensation of electronic equipment (REA) circuit elements. The study is carried out at the Girikond Scientific Research Institute, Leningrad. Figures 3; tables 1; references 2.

First Commercial Posistor Design for Current Protection of Electronic Equipment

927F0064C Moscow *PRIBORY I SISTEMY*
UPRAVLENIYA in Russian No 5, May 91 pp 30-31

[Article by G.N. Tekster-Proskuryakova, Yu.A. Gusev, Ye.A. Savchenko, M.Yu. Bystrova]

UDC 621.316.825.2

[Abstract] Temperature-sensitive resistors with a positive temperature coefficient of resistance (TKS)—the posistors—made from semiconductor solid solutions on the basis of barium titanate and their use in current protection circuits are considered. The first domestic posistor design (TRP-9) intended for current protection of power supply units in color video cassette recorders and its principal electric parameters are considered. The TRP-9 is executed as a disc with soldered electrodes protected by an insulating enamel. The posistor has a rated resistance of 10 and 15 Ω , a rated resistance tolerance of $\pm 30\%$, a maximum 60 V rating, and a rated current limit of 200 and 150 mA. Its switching temperature is 120°C. The current protection operation is illustrated by the dynamic characteristics plotted at various initial current values; the posistor flip-over time, i.e., the time it takes to decrease the initial current by twofold, decreases with an increase in the initial current. The TRP-9 time constant is 20 s. The new posistor may also be recommended for current protection in any circuit designed at operating at 60 V. The study is carried out at the Girikond Scientific Research Institute, Leningrad. Figures 9; tables 1; references 4.

Oxide-Semiconductor Thick Film Temperature-Sensitive Resistors

927F0064D Moscow *PRIBORY I SISTEMY*
UPRAVLENIYA in Russian No 5, May 91 pp 33-34

[Article by V.I. Zakharov, Yu.A. Gusev, A.O. Olesk]

UDC 621.316.825.3

[Abstract] The emergence of new types of temperature-sensitive resistors (TR) manufactured by thick-film microelectronics technology from semiconductor materials on the basis of manganese, cobalt, and nickel oxides formed on an aluminum oxide ceramic substrate is discussed and the designs, parameters, and applications of the thick-film temperature-sensitive resistors are described. Special attention is focused on the TR-5 (OZhO.468.257 TU)—the first domestic thick-film temperature-sensitive resistor—and a new TR with a 39-180 k Ω rated resistance. New original oxide-semiconductor

thermally sensitive resistor composites with a low sintering temperature of 900-1,100°C, a resistivity of 50-200 $\Omega \times \text{cm}$, and a negative temperature coefficient of resistance of $-(3.2-4/2)\%/^\circ\text{C}$ are described and the outlook for using them in microelectronic temperature gauges and other functionally complete devices integrated with other thick-film element on a TR substrate is evaluated. The study is carried out at the Girikond Scientific Research Institute, Leningrad. References 3.

Semiconductor Temperature-Sensitive Resistor-Based Temperature-Sensitive Elements

927F0064E Moscow *PRIBORY I SISTEMY*
UPRAVLENIYA in Russian No 5, May 91 p 34

[Article by V.S. Moskalev, L.A. Sverzhin, Moscow]

UDC 621.586.674

[Abstract] The development of temperature-sensitive elements on the basis of bead- and film-type temperature-sensitive resistors for use in specialized temperature instruments for turbines, heat exchangers, etc., is described and the principal specifications of the temperature-sensitive elements are summarized. Depending on the the specific design, they have a temperature range of -30 to +120°C or -50 to +120°C and a response lag of 5 or 10 s. Temperature-sensitive element bodies are made from stainless steel 12Kh18N10T or the AG-4V molded material. Tests reveal that the new temperature-sensitive elements have a high operating reliability and stable technical and metrological characteristics. Figures 1; tables 1; references 2.

Microprocessor Thickness Gauge

927F0064A Moscow *PRIBORY I SISTEMY*
UPRAVLENIYA in Russian No 5, May 91 pp 26-27

[Article by V.I. Loban, A.A. Pyzhyanov, L.K. Rukina, A.A. Fomin, V.A. Tsvetkov, Leningrad]

UDC 681.2

[Abstract] A microprocessor thickness gauge designed and manufactured by the Department of Information Measurement Engineering at the Leningrad State Engineering University under a contract with the Vesopribor plant in Bobruysk is described; the new gauge is an upgraded version of the MT-41NTs thickness gauge manufactured by the plant. The instrument is intended for measuring the thickness of nonmagnetic coats on a ferromagnetic base; it is capable of combining automatic calibration and correction. Its measurement range is 4-2,000 μm and its limit of error is $0.03X + 0.5 \mu\text{m}$. The instrument was exhibited at the fourth all-union exhibit of coat thickness gauges in Izhevsk in 1990. Thickness gauges can be manufactured to client specifications for any combination of base and coat materials with a narrower measurement range and expanded functional capabilities. Figures 1; tables 1; references 2.

Contactless Optical Displacement Transducer927F0066C Moscow PRIBORY I SISTEMY
UPRAVLENIYA in Russian No 7, Jul 91 pp 18-19

[Article by T.I. Murashkina]

UDC 531.714.2.084.2

[Abstract] The urgency of developing simple, accurate, and operationally reliable contactless longitudinal 0-500 mm displacement transducers (BDPP) is recognized and it is shown that optical contactless longitudinal displacement transducers (OBDPP) using the reflectometry method of obtaining primary data and the amplitude-phase method of processing them are the most suitable for this purpose; an amplitude-phase optical contactless longitudinal displacement transducer is described and its design is presented. The transducer contains a compensating channel for measuring longitudinal displacements; the operating principle of the transducer and the purpose of its components are described and mathematical relationships among its signals are derived. The functional dependence of the transducer output signal on the displacement under study is determined and analyzed. Experimental studies show that given ambient temperature fluctuations of $\pm 50^\circ\text{C}$, transducers with FD-19KK photodiodes have an error not exceeding 6%. Thus, the use of amplitude modulation of the luminous flux and phase modulation of the output electric signal makes it possible to develop optical contactless longitudinal displacement transducers with improved metrological characteristics and performance. The study is performed at the Penza Scientific Research Institute of Physical Measurements. Figures 2; references 8.

Effect of Accelerometer Sensor's Added Mass on Its Frequency Response927F0066A Moscow PRIBORY I SISTEMY
UPRAVLENIYA in Russian No 7, Jul 91 pp 14-15

[Article by V.A. Volkov, V.V. Ryzhanov, A.I. Tsapulin]

UDC 681.586.772

[Abstract] The effect of the added mass of the damping liquid on the natural frequency of the filled accelerometer sensor (ChE) is investigated; to this end, the added mass is characterized by the ratio of its volume to the sensor volume. The relationship between the sensor's working frequency band in the air and the resonant frequency of a filled accelerometer sensor and the lower and upper boundaries of the amplitude-frequency response of dry and filled accelerometers as well as the amplitude-frequency response of an accelerometer filled with different types of damping liquid are plotted. As a result, a formula is derived for linking the maximum attainable frequency band for a set accelerometer sensor design at a given amplitude-frequency response (AChKh) irregularity, inertial element mass, suspension

rigidity, density of the liquid, and sensor material density with the added mass coefficient, i.e., the ratio of its volume to the sensor volume. It is shown that in order to assess the frequency response (ChKh) of accelerometers, it is expedient to use the accelerometer dynamics equation and estimate the natural frequency of the sensor from two fixed frequencies. In order to ensure that the effect of the added mass is estimated unambiguously, it is necessary to take into account the frequencies at which the added mass is measured. The study is carried out at the Penza Scientific Research Institute of Physical Measurements. Figures 2; tables 2; references 9.

Quick-Response Posistor Sensors for Electrical Machine Temperature Protection927F0065B Moscow PRIBORY I SISTEMY
UPRAVLENIYA in Russian No 6, Jun 91 pp 22-23

[Article by Yu.A. Gusev, M.B. Druzhinina, I.V. Markevich, Ye.N. Solovyeva, G.N. Tekster-Proskuryakova]

UDC 621.315.422.3:621.316.825.2

[Abstract] The use of posistors as temperature-sensitive element sensors (ChE) in built-in temperature protection systems (VTZ) of electric motors and generators due to their specific temperature dependence of resistance and the possibility of shifting this curve in the temperature scale is discussed and a new series of quick-response posistor temperature-sensitive element sensors operating in the $90-160^\circ\text{C}$ temperature band and tunable in 10°C steps is described. The new products are designated TRP-10-90 - TRP-10-160. The posistor design is presented and principal posistor sensor specifications and operating characteristics are summarized. Series TRP-10 posistors have a time constant not exceeding 5 s. The sensors ensure temperature protection for new consolidated series AC motors and expand temperature protection applications and increase its reliability. In addition, TRP-10 may be used in temperature control and alarm systems, etc. The study is carried out at the Girkond Scientific Research Institute, Leningrad. Figures 4; tables 2; references 2.

Use of Varistors as Temperature-Sensitive Element Sensors With Linear Response927F0065C Moscow PRIBORY I SISTEMY
UPRAVLENIYA in Russian No 6, Jun 91 pp 23-24

[Article by I.P. Rayevskiy, F.K. Medvedev, M.A. Malitskaya, S.P. Teslenko, S.A. Trusova, V.G. Poltavstev]

UDC 681.586.16:621.315.592

[Abstract] The use of transducers, e.g., temperature-sensitive elements, employing solid-state semiconductor devices with a nonlinear voltage-current characteristic, i.e., polycrystalline varistors (PKV) but with a

linear output response is summarized and the temperature coefficient of voltage drop (TKN) of such polycrystalline varistors in a direct current mode, the dependence of the temperature sensitivity of polycrystalline varistors on their thickness, and the dependence of the temperature sensitivity of polycrystalline varistor sensors on the measurement current are plotted. The measurement procedure is described. The principal specifications of temperature-sensitive elements with polycrystalline varistor sensors made from ZnO (VR-1), SiC (SN1-2), $\text{SnO}_2\text{:Sb:Co}$, $\text{TiO}_2\text{:Nb:Ba}$, $\text{SrTiO}_3\text{:Nb:Mn}$, and $\text{BaSnO}_3\text{:Sb:Fe}$ are summarized. In addition to higher values of the temperature coefficient of voltage drop, the advantages of polycrystalline varistors over devices with *p-n*-junctions include the independence of characteristics from the measurement current polarity and the possibility of manipulating the sensors' response within a wide range both during their manufacturing (by manipulating their thickness) and during measurements (by changing the current). The study is carried out at the Girikond Scientific Research Institute, Leningrad, and Physics Scientific Research Institute at the Rostov State University. Figures 3; tables 1; references 3.

Semiconductor Pressure Pickup With Increased Reliability and Improved Technical Effectiveness

927F0065D Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 6, Jun 91 p 25

[Article by L.V. Sokolov, Moscow]

UDC 681.586:621.3.049.77

[Abstract] A semiconductor pressure pickup intended to increase the reliability of resistance strain gauge structures based on a Wheatstone bridge with metal membranes under cyclical temperatures of 223-513K and linear and vibrational load factors is described and its block diagram and calibration curve are cited. The pickup has a pressure range of 0-120 kPa and a vibration frequency band of 0-2,500 Hz. Tests demonstrate that the pickup withstands vibrational load factors of up to 10 g both along and perpendicular to the membrane plane and linear load factors of 80 g along the membrane plane and 20 g perpendicular to the membrane plane. It remains serviceable at a relative humidity of 98%. The new pressure pickup does not require the use of precious metals. Figures 2; tables 1; references: 2 Western.

Thin Film Heated Electrolytic Humidity Sensor

927F0065E Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 6, Jun 91 p 26

[Article by T.A. Dyakonova, V.Ye. Lystsev]

UDC 551.508.7

[Abstract] A heated electrolytic dew point transducer developed on the basis of thin film technology is

described; its operating principle is based on the one-to-one relationship between the three-phase equilibrium temperature of the salt crystals-solution-water vapors system and the quantity of water vapors in the ambient medium. The current passing through the surface layer of the moisture-absorbing sensor substance determines its heating to the three-phase equilibrium temperature, given a dynamic equilibrium between the absorbed and vaporized quantities of moisture, and the equilibrium temperature is determined by the electric resistance of the temperature sensitive element. The sensor consisting of moisture- and temperature-sensitive and heating units has a dew point measurement range of -66 to +28°C and ambient temperature range of -60 to +30°C; its absolute dew point measurement error does not exceed 0.5°C and absolute temperature measurement error is 0.1°C. Tests demonstrate that sensor characteristics may be improved further and that the sensor could be integrated with microprocessor systems. The study is carried out at the Instrument-Making Scientific Research Institute in Moscow. Figures 1; tables 1.

MIS Structure-Based Hydrogen Sensor

927F0065F Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 6, Jun 91 pp 26-27

[Article by V.P. Kozlenkov, I.N. Nikolayev]

UDC 631.382

[Abstract] A small instrument for measuring the hydrogen concentration developed on the basis of a metal-insulator-semiconductor (MDP) structure of palladium-silicon dioxide-silicon is described. A 50 nm thick palladium film is applied to a 100 nm thick silicon dioxide film which is thermally grown on *n*-type silicon wafer. The electrode area is 1 mm². The dependence of the signal strength on the digital indicator input on the hydrogen concentration (in ppm) and the instrument's dynamic response at a 1,000 ppm concentration are plotted. The sensor has a sensitivity threshold of 20 ppm. A month-long test at hydrogen concentrations of up to 1,000 ppm did not reveal any parameter spread while an extended periodic exposure to hydrogen at a 1% level led to a 10-20% deterioration of sensitivity due to the mechanical stresses developing in the palladium film and on its interface with the oxide. The sensor is among the first such instruments developed in the country. Subsequent research must be aimed at decreasing its dimensions and developing a self-contained power supply. The study is carried out at the Moscow Engineering Physics Institute. Figures 2; references: 2 Western.

Gastroenterology Probe

927F0065G Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 6, Jun 91 p 27

[Article by Yu.I. Zaganyach, A.P. Kutrakov, T.M. Ivashchuk (deceased)]

UDC 531.787:621.315

[Abstract] A special probe for diagnosing stomach and gastrointestinal tract disorders consisting of two pressure transducers and a pH-meter making it possible to measure the intracavitary pressure which indirectly reflects the motor function of the gastrointestinal tract organs which, in turn, serves as an indicator of certain digestive organ diseases is described. The probe has a pressure measurement range of $0-4 \times 10^4$ Pa. The two pressure transducers in the probe—one for the stomach pressure and the other one for the duodenum pressure—take measurements simultaneously. The pressure transducers are designed on the basis of resistance strain gauges. A study shows that the digestive tract is characterized by periodic motor action; the period duration and pressure gradient in the organs are established. The study is carried out at the Lvov Polytechnic Institute; tables 1; references 1.

Determining Nonlinearity and Hysteresis of Low-Pressure Manometers

927F0066B Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 7, Jul 91 pp 17-18

[Article by A.P. Bazhanov, V.A. Kryukov, Ye.V. Kulikov, V.A. Soshnikov]

UDC 531.787.084.2.039.6

[Abstract] Calibration curve nonlinearity and hysteresis measurements of manometers with a pressure range under 2×10^2 Pa with a 1-2% accuracy and the shortcomings of existing methods are discussed. A new method of measuring the low-pressure manometer nonlinearity and hysteresis is proposed; output signals of the manometer under study uniformly distributed in its calibration curve are used for assigning pressures. The method and the corresponding device does not call for using reference manometers and make it possible to shorten the calibration procedure. They also make it possible to simplify the calibration process and increase the nonlinearity and hysteresis measurement accuracy. The steps involved in the ascending and descending gauge pressure calibration procedure are outlined. The study is carried out at the Penza Scientific Research Institute of Physical Measurements. Figures 3; references 2.

Sh711/1 Multichannel Digital Transducer

927F0066D Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 7, Jul 91 pp 20-22

[Article by V.M. Mashenkov, Yu.A. Notkin, Yu.I. Vizgin, I.V. Kovalevskiy, K.N. Lopatka, Yu.I. Ro]

UDC 621.317.311/32:681.325.5-181-48

[Abstract] The Sh711/1 multichannel digital transducer (MIP) developed and commercially implemented by the All-Union Scientific Research Institute of Electric Instruments (VNIIEP, Leningrad) and its spark-safe version Sh711/1-I developed in cooperation with the Zakarpatribor Production Association in Uzhgorod are described. The instruments are intended for converting analog electric signals from temperature-sensitive elements and voltage and current signals into the KOI-7 standard code for information interchange and other codes. The transducers have more than 60 input channels and are capable of compensating for the effect of temperature on cold thermocouple (TP) junctions and performing other functions. The transducer block diagram is presented and its principal specifications are summarized. The Sh711/1 is executed as a single module encased into a molded housing; it has passed state acceptance tests and is being manufactured on a commercial scale by the Elektrotokhpribor plant in Omsk and the Zakarpatribor Production Association in Uzhgorod (the Sh711/1-I version). Figures 3; tables 1.

FET Parameter Meter for Process Control Structures

927F0066E Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 7, Jul 91 pp 22-23

[Article by V.F. Ryzhkov, V.I. Ryabinin, A.A. Chumakov]

UDC 621.317

[Abstract] The need for a device for measuring the parameters of field effect transistors which characterize the quality of integrated circuit chips (IMS) during their development and production is identified and an instrument for measuring the static characteristics of test FET's (IPT) developed at the Kontrolpribor Scientific Research Institute in Penza is described. The static FET parameter meter is intended for measuring the threshold, punch-through, and breakdown voltage and transconductance in field effect transistors; block diagrams for measuring the above FET characteristics are presented and the measurement procedures are outlined. The FET static characteristic meter's specifications are cited; its voltage measurement error does not exceed 0.1% and its transconductance measurement error is 5%. For operating simplicity, the transducer is equipped with a device making it possible to switch its input terminals in an arbitrary order. It can be controlled from the front panel or remotely; measurement data are output to a

digital display and an outside connector assembly. Figures 3; tables 1.

Displacement Transducers With High-Frequency Ultrasonic Raster

927F0065A Moscow *PRIBORY I SISTEMY UPRAVLENIYA* in Russian No 6, Jun 91 pp 21-22

[Article by V.Yu. Snitko]

UDC 621.37/39.634

[Abstract] The advantages of raster displacement transducers which use surface acoustic waves (PAV) generated by interdigital transducers (VShP) with a planar

structure capable of generating gigahertz frequencies and measuring displacements of up to 250 mm are described and their operating principles are outlined; block diagrams of acoustooptic interaction-based transducers are presented. The electrical and electromagnetic methods of data pickup from the displacement transducers are described and their specifications are cited. An analysis of the transducer performance demonstrates that surface acoustic wave transducers are comparable in efficiency to laser interferometers; yet when used in precision positioning systems, such transducers are cheaper than laser interferometers by tenfold. The study is carried out at the Vibrotekhnika Scientific Center of the Kaunas Polytechnic Institute. Figures 2; references 5: 3 Russian; 2 Western.

END OF

FICHE

DATE FILMED

5, May 1992